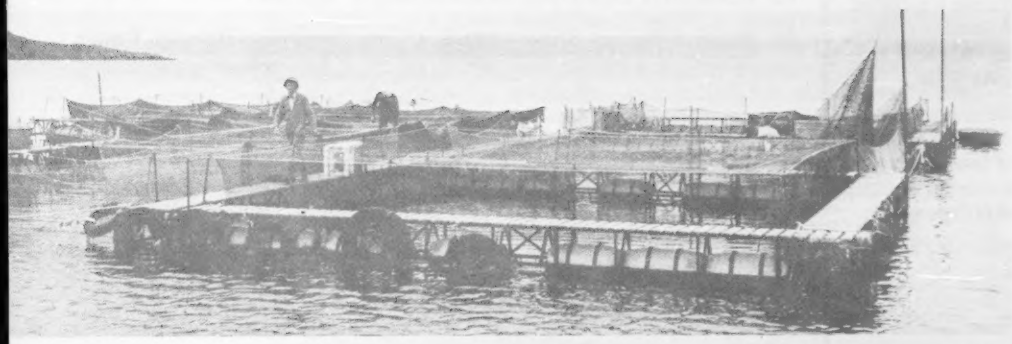
Volume 38 Number 8 August 1976

Marine Fisheries REVIEW

National Oceanic and Atmospheric Administration • National Marine Fisheries Service



FRANCE FARMS THE COHO SALMON

U.S. DEPARTMENT OF COMMERCE
Elliot L. Richardson, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator

National Marine Fisheries Service
Robert W. Schoning, Director

Marine Fisheries Review is published monthly by NMFS Scientific Publications Staff, Room 450, 1107 N.E. 45th St., Seattle, WA 98105.

Publication of material from sources outside the Service is not an endorsement. The Service is not responsible for the accuracy of facts, views, or opinions of these sources.

Although the contents have not been copyrighted and may be reprinted freely, reference to source is appreciated.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director, Office of Management and Budget, through May 31, 1978.

Editor: J. D. Harrell
Managing Editor: W. Hobart

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Price $1.10 (single copy). Subscription price: $12.75 a year, $15.95 a year for foreign mailing. Controlled circulation postage paid at Seattle, Wash.

Marine Fisheries Review

Vol. 38, No. 8
August 1976

CONTENTS

Articles

1 Coho Salmon Farming in France, Yves Harache and Anthony J. Novotny

9 Bowhead Whale Field Studies in Alaska, 1975, Willman M. Marquette

18 Utilization of the Bowhead Whale, Geoffry M. Carroll

22 Resource Ecology Data Analysis at the Northwest Fisheries Center (NWFC), F. Favorite, D. J. Brown, and W. J. Ingraham, Jr.

Departments

26 NOAA/NMFS Developments

31 Foreign Fishery Developments

38 Publications

40 In Brief . . . .

Cover.—Scenes from France's coho salmon farming program. See article beginning on page 1.

MFR PAPER 1194

Coho Salmon Farming in France

YVES HARACHE and ANTHONY J. NOVOTNY

ABSTRACT—The coast of Bretagne (Brittany) in France offers many suitable sites for salmon aquaculture. Seawater temperature varies from 8 to 18.5°C, but unusual climatic conditions may induce peak temperatures of 20°C. Coho salmon research was induced in France in 1971 by a CNEXO-COB (Centre National pour l'Exploration des Oceans/Centre Oceanologique de Bretagne) research team, in close relationship with NOAA-NMFS specialists. The results in freshwater-rearing were excellent, with high survival and good growth under natural conditions, leading to a large percentage of young-of-the-year (0-age) smolts. The first year of operation of an experimental saltwater, diked, tidal pond produced 7.6 metric tons of coho salmon in 1974 and 22 tons in 1975. Another pilot plant, built in June 1974, used net-pens in the Rade de Brest and produced about 4 tons.

Late spring and summer adaptation of smolts to seawater showed heavy mortality during the summer of 1974 and 1975, possibly due to high temperatures associated with high salinities. No evidence of bacterial infection was found in 1974, but Vibrio *sp. was isolated from dying fish in 1975. However, the surviving fish showed excellent growth. Part of the 0-age 26 g smolts, adapted in July 1974, reverted to parr condition with a poor growth, while the other part of the population reached an average weight of 397 g by 31 December (1.58% daily weight increase) and 735 g by 10 April 1975. Large 1-year smolts averaged 522 g by 31 December (1.25% daily weight increase) and 1,050 g by 9 April 1975. The salmon are reared in saltwater from October to May, when the sea temperature is below 13°C. The coho are marketed in France—fresh, whole, and in the size range of 0.3-0.8 kg. Market prices and acceptance are excellent. Total production should approach 100-120 tons in 1976 in three operating farms.*

RÉSUMÉ—Les côtes de Bretagne en France offrent un certain nombre de sites favorables à l'aquaculture du saumon. Les températures de l'eau de mer varient de 8 à 18,5°C mais des conditions climatiques exceptionnelles peuvent entraîner des températures proches de 20°C en été.

L'équipe d'aquaculture du Centre Océanologique de Bretagne débuta un programme de recherche sur l'élevage du saumon COHO en 1971.

Les résultats de l'élevage en eau douce furent excellents avec un fort pourcentage de survie et une bonne croissance dans les conditions naturelles, entraînant un pourcentage élevé de smolts d'âge 0.

La première année de fonctionnement d'un étang à marée expérimental permit de commercialiser 7,6 tonnes de saumon COHO en 1974 et 22 tonnes en 1975. Une autre structure pilote utilisant des cages flottantes en rade de Brest fut achevée en juin 1974 et produisit environ 4 tonnes de saumon dont 2 furent commercialisées.

Les adaptations de smolts à l'eau de mer à la fin du printemps et en été se traduisirent par de fortes mortalités estivales en 1974 et 1975, pouvant être attribuées aux températures élevées associées à une forte salinité. Aucune infection bactérienne ne fut mise en évidence en 1974 mais Vibrio *sp. fut isolé en 1975.*

Cependant les poissons survivants présentèrent une croissance excellente. Une partie des smolts d'âge 0 (26 g) adaptés en juillet 1974 régrèsserent a l'état de parr avec une faible croissance alors que le reste de la population atteignait un poids de 397 g le 31 décembre 1974 (croissance journalière: 1,58%) et 735 g le 10 avril 1975.

Le smolts de 1 an (70 g) transférés en cages flottantes en juillet 1974 atteignirent un poids de 522 g au 31 décembre 1974 (croissance journalière: 1,25%) et 1050 g le 9 avril 1975.

La production en eau de mer est actuellement programmée d'octobre à mai quand la température de l'eau est inférieure à 13°C.

Les saumons sont commercialisés en France frais, entiers dans la gamme de poids de 0,300 à 0,800 kg.

Les prix obtenus et l'acceptation sont excellents.

La production totale devarait approcher 100 à 120 tonnes en 1976 grâce à de nouvelles installations.

Harache

Novotny

Yves Harache is with the Centre National pour l'Exploration des Océans, Centre Oceanologique de Bretagne, Brest, France. Anthony J. Novotny is with the Northwest Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, WA 98112.

This article is a contribution from the U.S./France Cooperation in Oceanology formally organized in 1972 by Yves La Prairie, Président -Directeur Général, Centre National pour L'Exploitation des Océans (CNEXO), and Robert M. White, Administrator, NOAA. James E. Hanks, Middle Atlantic Coastal Fisheries Center, National Marine Fisheries Service, Milford Laboratory (Conn.), is the NOAA Aquaculture Leader and Jacques Le Noan, Department Chief "Living Resources", Paris, is CNEXO representative for the aquaculture aspect of the Cooperation.

INTRODUCTION

Historically, the European consumer has been accustomed to Atlantic salmon, *Salmo salar*, as his first choice. However, due to the high cost of obtaining wild Atlantic salmon (which are in short supply), he has made some movement toward the more plentiful (and economical) Pacific salmon, *Oncorhynchus* spp., which is now an established consumer product.

Before the French Revolution, it is claimed, the rivers of Bretagne (Brittany) were producing over 4,500 metric tons of Atlantic salmon a year. The actual catch now is about 10 to 15 tons, and the additional high seas fisheries off Greenland of 2,500-3,000 tons is enough to endanger the species. The main causes of this disastrous diminution of Atlantic salmon are lack of management, overfishing, unadapted legislation, degradation of the environment, and an almost total absence of smolt-rearing facilities for restocking the rivers. This makes it impossible to obtain eggs from wild stocks of Atlantic salmon in France.

The French coastline, particularly that of Bretagne in the North, has geographical and climatic conditions apparently favorable to salmon farming. The Bretagne economy is partially based on exploitation of the sea, but traditional fishermen are now interested in developing aquacultural activity. Twelve rivers of Bretagne still support some small natural runs of Atlantic salmon.

Sea surface temperatures fluctuate from 8 to 18°C, with optimum range of 10 to 16°C, 9 months of the year. In 1975, the highest atmospheric temperatures recorded in Bretagne since the beginning of the century led to surface temperatures of 20-22°C in deep bays and estuaries, while the open sea surface temperatures approached 19°C.

The salinity of most of the sites deemed suitable for salmon farming range from 29-35‰. Tidal amplitudes range from 5 to 12 meters, depending on the area. This characteristic pr vides good renewal of water but limits the number of suitable sites. Storms occur frequently during the fall and winter months. Consequently, fish fa.ms have to be protected from oceanic swell and, if possible, from the dominant southwesterly winds.

Studies of the seawater culture of coho salmon, *O. kisutch*, pioneered by the National Marine Fisheries Service (NMFS) in Puget Sound, Wash., indicated that the Pacific coho might be adaptable to the environmental conditions in the region of Bretagne. NMFS cooperative pilot farm studies proved that the coho could be grown to a marketable size in less than 18 months from fertilization of the egg, at a final production level of 250 tons per surface acre (Novotny, 1975). Thus, the Pacific coho, which are much easier to rear in fresh water than Atlantic salmon and less exigent about water quality, were chosen for the first French salmon farming tests.

The first eyed coho eggs (60,000) were purchased in December 1971 from the Washington State Department of Fisheries and were reared in fresh water in Bretagne under contract with a private fish farm. A second shipment of 200,000 eggs was received at the end of 1971, partly from the Oregon Department of Fish and Wildlife (Alsea River) and partly from the Bureau of Sport Fisheries and Wildlife (Eagle Creek National Fish Hatchery).

In 1973, CNEXO-NOAA cooperation was formally instituted for the development of coho salmon farming in France. NOAA furnished 250,000 eyed coho eggs to CNEXO, and exchanges between scientists of CNEXO's Center Oceanologique de Bretagne (COB) and NOAA's Northwest Fisheries Center of the National Marine Fisheries Service were arranged. In late 1973, a survey of possible net-pen culture sites in Bretagne was conducted by American and French scientists. In 1974, one million eyed coho eggs were obtained by French salmon rearers from U.S. hatcheries.

At the same time, two ways of rearing coho salmon to commercial size were planned: 1) Using old mill tidal ponds which are quite frequent along the sea shore and the river estuaries of Bretagne; and 2) Selecting sheltered sea areas where salmon could be reared in floating net-pens.

A pilot company, the Société pour le Développement de l'Aquaculture en Bretagne (SODAB), was organized in 1973 with CNEXO as the major owner. Two other farms using floating net-pens in open seawater were developed in 1974 and 1975 with fishermen's cooperatives.

FRESHWATER CULTURE

The first 2 years of operation (1972-73) were tests of the ability of operators to produce good survival and early growth of coho in the natural environment of the freshwater experimental hatchery. At the same time, studies were conducted at the COB laboratory concerning the size of fish and time of entry into seawater of coho smolts.

The fish were raised in the hatchery on a dry pelleted ration of French formulation and manufacture. The overall survival of the first lot of coho was only 50 percent at the end of the first year. However, the survival of the lots of the following year was 85 percent and 96 percent for one year's growth, and average weight was 50 g (Harache,[1] 1974). Eyed Atlantic salmon eggs were obtained from Scotland and cultured at the same hatchery at the same time. By contrast, the survival of Atlantic salmon at the end of the first year was only 4 percent, and the average size was less than 10 g. All fish were reared in 10-11°C reused spring water until the stream waters reached 10°C (April). In 1974, the survival was about 80 percent; in 1975, an upstream discharge of a pollutant destroyed 400,000 0-age coho in early May.

Only a small number, approximately 20 percent, of the 1971 brood progeny exhibited signs of smolting as 0-age fish in July (15-20 g) and October (35 g) of 1972. The progeny of two lots of 1972 brood eggs showed remarkable differences. Over 50 percent of the progeny of the Alsea River Hatchery parent stock smolted before the end of the first year's growth (0-age). Virtually 100 percent of the progeny from Eagle Creek Hatchery parent stock, which started feeding 3 weeks later, smolted as yearlings. However, the average size of Eagle Creek yearlings was 70 g in May 1974, which is exceptionally large. The smallest fish of the Eagle Creek stock, kept in fresh water until October 1974, weighed 150 g. In July 1974, 59 percent of the 1973 brood Eagle Creek stock were smolted as 0-age fish.

The significance of high survival and excellent growth of coho salmon in Bretagne, which had no alterations of the natural freshwater environment cannot be overlooked.

SEAWATER CULTURE

Rearing Facilities

SODAB developed a diked tidal pond (Moulin du Carpont) on the estuary of the river Jaudy for marine production (Fig. 1). The pond, which has a surface area of 6,000 m^2, is held at an average depth of 4 m, regardless of the tide. Water for the pond is produced by two 600 m^3 per hour (5.9 cubic feet per second) pumps which can work from 9 to 11 hours daily. A circulating pump in the pond moves 3,600 m^3 of water per hour (35 cubic feet per second) and induces a continuous current. At the higher tides, water can be partially renewed by gravity. The salmon are cultured in 16 Norwegian-type floating octagonal pens (Fig. 2). Pen volumes range from 193 to 230 cubic meters each. In 1975, a submersible dike was built below the upper pond, creating an additional pond with a surface area of 2,000 m, suitable for rearing. Submerged at each high tide, the dike keeps a 4-m water depth inside the lower pond which contains 12 octagonal net-pens (Harache, 1974).

Theoretical loading capacities for the upper pond were calculated by the CNEXO-NOAA team for several size ranges of coho. The studies were based on probable temperatures, oxygen saturations, oxygen consumption, and oxygen renewal. Surveys of the tidal ponds are being conducted to determine the possibilities of using this kind of pond for intensive production.

Figure 1.—Bretagne region in France, showing the locations of the diked tidal pond at Moulin du Carpont, and L'Auberlach Bay in the Rade de Brest (Brest Sound). Brest is in the same latitude as central Puget Sound, where coho salmon have been successfully cultured on a commercial scale.

Another pilot plant, much smaller, has been developed in a partially sheltered bay of Rade de Brest. A steel-pipe raft (Fig. 3), with four 60 m^3 (3 m deep) pens made of knotted nylon mesh, was installed in early June 1974

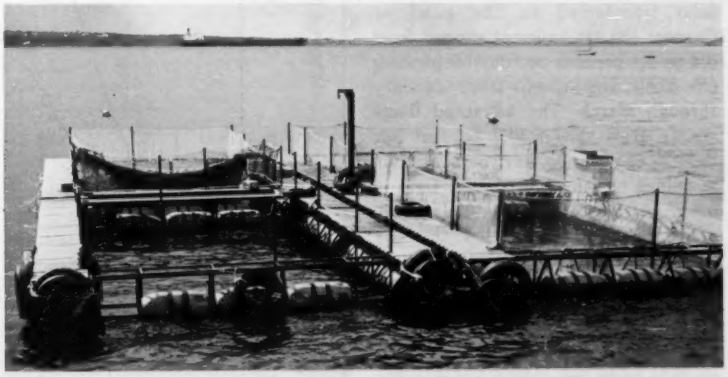


Figure 2.—Floating net-pens in the diked tidal pond at Moulin du Carpont. The Norwegian type octagonal pens are 2.5 and 3 meters deep and have volumes ranging from 193 to 230 cubic meters.

[1]Harache, Y. 1974. Premiers resultats de l'elevage experimental du saumon coho (*Oncorhynchus kisutch*). *In* L. Laubier and D. Reyss, Colloque sur l'Aquaculture, 22-24 Oct. 1973, Brest, p. 343-356. Publ. Cent. Natl. Exploit. Oceans (CNEXO), [Fr.], Ser.: Actes Colloq. 1. (Processed report.)

(Virmaux,[2] 1974 and Danioux et al., 1975). Water depth in this bay varies from 4.2 to 9 m depending on the tides. Current velocity does not exceed 0.3 m per second but wave amplitude can reach 1.5 during southwest storms in winter.

This operation is conducted in close cooperation with a fishermen's cooperative, Cooperative Maritime Aquacole du Tinduff (COMAT) that is in charge of the operation. CNEXO-COB is responsible for the technical and scientific advice and the cost of operation. After a 1-year test of the structures, five commercial size rafts with 8.5× 8.5×3.5 m deep net-pens were installed and stocked with coho in early November 1975. This raft provides 2,200 m of space in which 30 to 35 tons of salmon could be produced in the future.

A third experimental station using two octagonal Norwegian-type pens is operating in the estuary of the Jaudy, close to Carpont. The current velocity of 2 knots can be considered a limiting factor in these conditions. These three projects are followed very closely by CNEXO biologists on a comparative growth and cost basis.

First Marine Production of Coho in France

The dike tidal pond at Carpont was completely equipped at the end of 1973. The first floating net-pens were installed during December 1973 and January 1974 with coho from the 1971 and 1972 parent brood stocks, ranging in size from 180 to 500 g.

The average weight increases of the coho transferred to the pond at Carpont (30-35‰salinity) ranged from 0.4 to 1.1 percent per day (depending on stock and sizes) from January through March. The advanced 0-age smolts grew slower (0.7 percent per day) in the marine environment than yearlings of the same size at time of entry (1.0 percent per day). In these stages, the fish were fed the dry pelleted ration, and mortality up to spring and early summer harvesting was almost negligible.

[2]Virmaux, J. F. 1974. Etude sur les cages flottantes pour l'aquaculture. Mem., Ec. Natl. Ing. Trav. Ruraux Tech. Sanit., Strasb., and CNEXO, Cent. Oceanol. Bretagne, Plouzane, Fr. 220 p. (Processed report.)

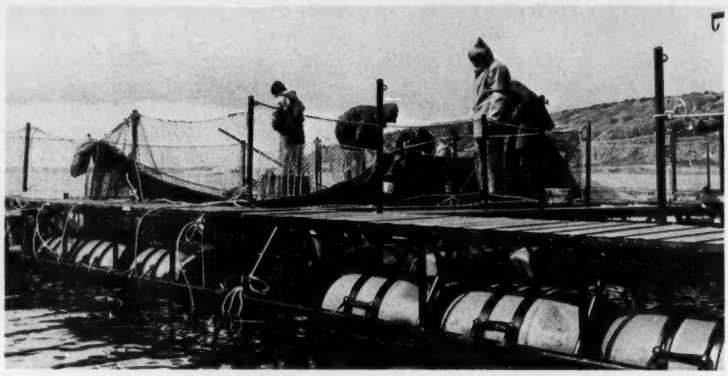


Figure 3.—Floating rigid pen-frame system and net-pens in L'Auberlach Bay, Brest Sound. Note the polyethylene kegs for flotation. Wave height can reach 1.5 meters (4.9 feet) in this bay.

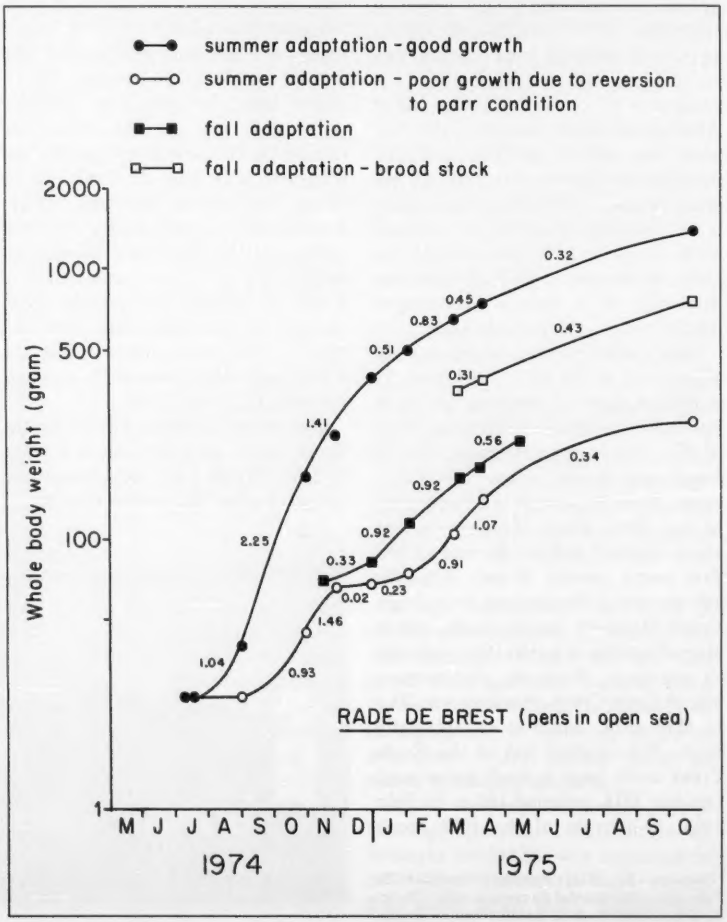


Figure 4.—Growth of zero age coho smolts in seawater. Values above the lines are the specific growth rates in percent of weight increase per day between measurement periods.

In 1974-75, we attempted to adapt 0-age and yearling smolts during June and July, when the seawater temperature was about 15°-17°C. In all the tests, mortality during the first 2-4 weeks was high with some apparent differences in each environment. The 30-day mortality of 0-age smolts (20 g) in 1974 was 100 percent in the diked tidal pond at Carpont, 95 percent at the COB laboratory, and 40 percent in the net-pens of the Rade de Brest. No evidence of disease was found in spite of alarming disease-like external symptoms. The mortality increased with time, reaching 100 percent at COB and 78 percent in the net-pens. Approximately 50 percent of the surviving fish grew well from September (1.6 percent daily increase) until late December and reached an average weight of 735 g by mid-April 1975 and 1,373 g by late October 1975 (Fig. 4). The majority of the remaining 50 percent reverted to parr condition, and growth was very poor. The fish were fed a dry pelleted ration with a food conversion rate of 1.35:1 until December 1975 and 1.7:1 in April 1975.

Yearling smolts (50 to 80 g) were transferred to 34.5‰ seawater in May and June 1974 (14° to 17°C) at the COB laboratory for experimental purposes and into a reduced segment of the Carpont tidal pond. Growth was very poor due to excessive handling and poor environment, but mortality was not excessive until July when temperatures reached 18.5°-19°C in Carpont and 17.5°C at COB. *Aeromonas salmonicida* was isolated at COB when 500 fish (averaging 72 g) in stressed condition were transferred from the COB laboratory to the net-pens in Rade de Brest at the end of July when seawater temperature was 17.2°C. (35.5‰ salinity). The mortality of these stressed fish was 72 percent in the first 3 days following transfer. However, the surviving fish grew well, reaching an average weight of 262 g by late October (1.3 percent weight increase per day) with a 1.7:1 food conversion and 522 g weight by late December (1.1 percent weight increase per day) with a 1.8:1 food conversion (Fig. 5). In April 1975, the average weight was 1,050 g with a 2.3:1 food conversion, and by late October the average was 1,590 g. At Carpont, the mortality of the same stock of fish was in excess of 90 percent, and the average weight gain was 0.7 percent per day during the first period and 0.9 percent per day during the last period. These fish were observed until early March 1975 when the average weight was 525 g (Fig. 6). The lower growth obtained in the closed pond may possibly be attributed to low levels of dissolved oxygen.

Figure 5.—Subsampling of winter coho by the CNEXO-COB biological team just prior to harvest. Floating pens in L'Auberlach Bay, Brest Sound.

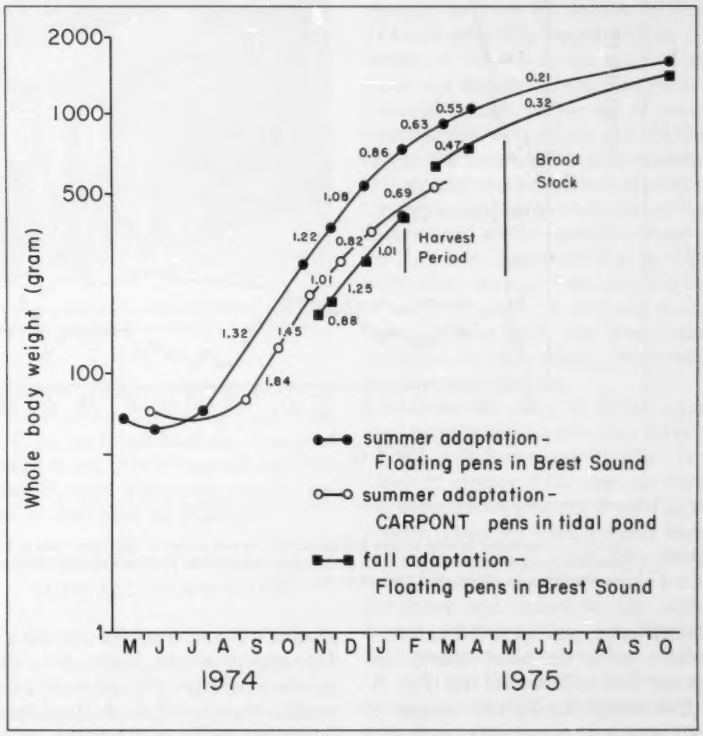


Figure 6.—Growth of yearling coho in seawater. Values above the lines are the specific growth rates in percent of weight increase per day between measurement periods.

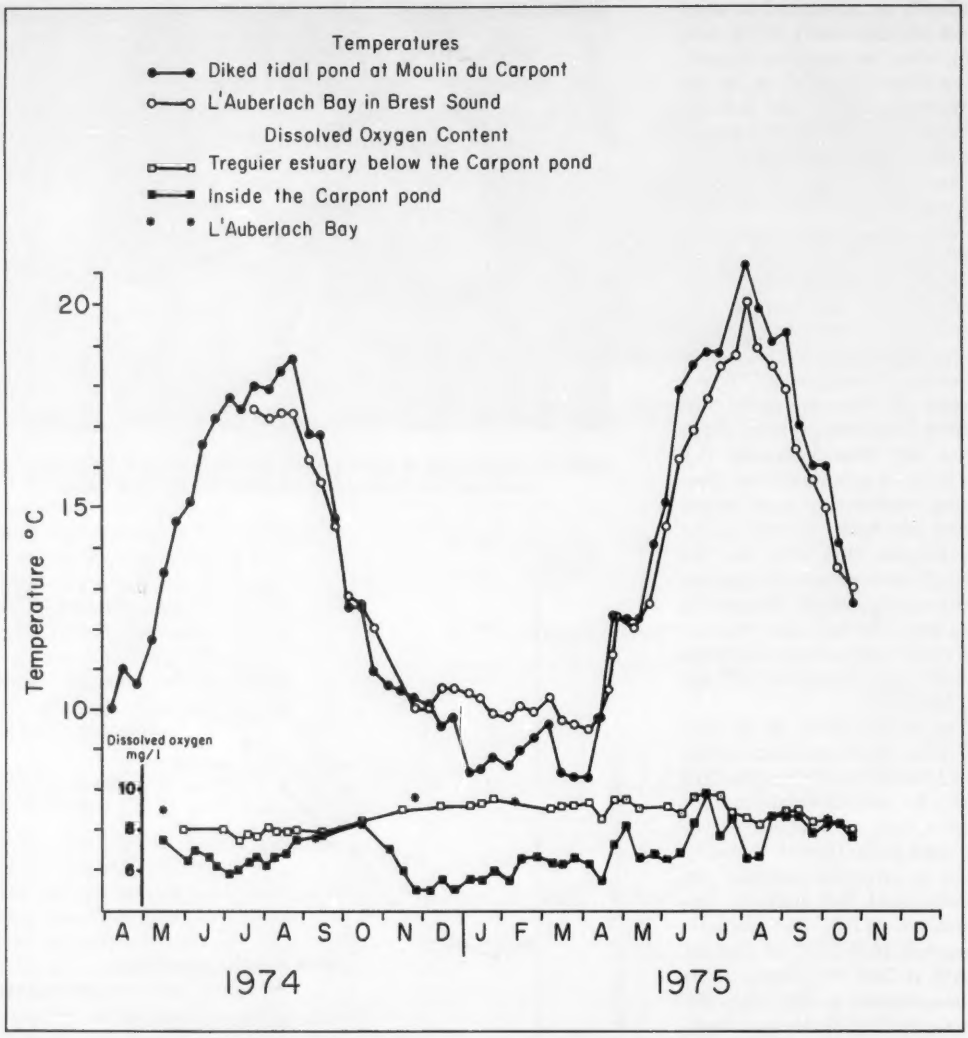


Figure 7.—Seawater temperatures and dissolved oxygen values in the diked tidal pond and in L'Auberlach Bay in Brest Sound. Dissolved oxygen values for the open estuary just outside the pond are also given. Note the differential in oxygen values when the production level reached 15 tons in late 1974.

Dissolved oxygen fell to 5-6 parts per million when the pond density approached 15 to 20 tons of fish (Fig. 7).

The results during the summer of 1975 were even worse, with a mortality in excess of 95 percent at all sites with unusually high temperatures. *Vibrio* sp. were occasionally isolated from dead or dying fish, but vibriosis could not be confirmed as the major cause of mortality.

In the fall of 1974, fish were adapted in the Rade de Brest and Carpont, either as 0-age large fall smolts (70-100 g) or as 1-18 month smolts (150-200 g). The growth of the larger fish was excellent with a 1.01 percent daily weight increase in Rade de Brest from November 1974 to February 1975. Brood stock isolated from this group reached an average weight of 1,350 g in late October.

The results with 0-age smolts were different. Coho smolts weighing 80-100 g at the time of saltwater entry had good growth and survival. Fish smaller than 70 g at saltwater entry had low growth rates but no mortality (Fig. 8).

The first coho cultured in the sea in France were harvested in April 1974 by SODAB and shipped to markets in Paris. The fish were in excellent condition—bright, silvery, good body shape, no blemishes, firm, and with good flesh color. The fish were harvested once or twice each week; they were stunned and packed whole in ice in styrofoam cartons at a total carton weight of about 10 kg. The individual weight range of marketed fish was 300-800 g, representing single portion meals or enough for two persons.

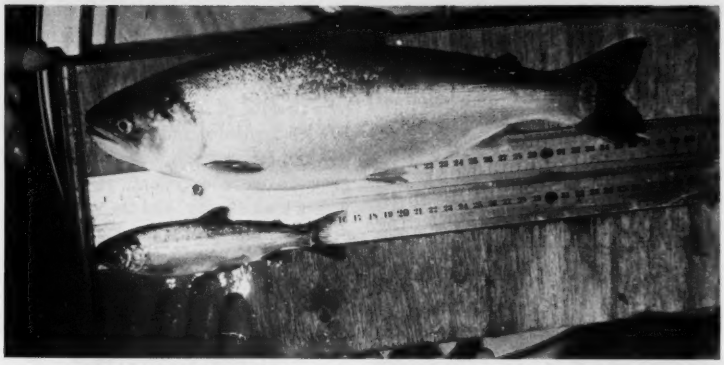


Figure 8.—Market size French coho. Coho averaging 70 grams in late July (smaller fish) reach an average of 700 grams after just 6 months growth in seawater (large fish).

Figure 9.—Two-year-old maturing male coho in the net-pens in L'Auberlach Bay. These fish are considerably smaller than the 3-year-old mature coho from the diked tidal pont at Carpont.

Marketing continued until July, when a total of 6.2 metric tons had been shipped. New stocks of coho were introduced to Carpont from the freshwater hatchery in October 1974, and harvesting resumed in mid-December to accommodate the demand for the holiday trade. The overall production to market was 7.6 metric tons by 31 December 1974. From January to June of 1975, about 25 tons were sent to market, both by SODAB (22.5 tons) and COMAT (2.5 tons), all from fall adapted fish.

The prices paid to the salmon farmer averaged 20 Francs (F) per kg (US$2.00 per lb) for the whole fish on the Paris wholesale market, which is good. The slightly smaller coho cultured and sold in the United States are now bringing Puget Sound farmers about 14 F per kg (US$1.44 per lb) dressed. The weight loss averages 18-20 percent on dressed fish. In the French wholesale market, this new product is bringing French farmers an average 16.6 percent of the U.S. prices. In addition, the farmers of SODAB and COMAT do not have the labor expense of dressing the fish, nor the storage costs for freezing.

DEVELOPMENT OF FRENCH COHO AND BROOD STOCK

Although the CNEXO project must rely on the shipment of coho eggs from the United States for the present, the eventual goal is to develop self-sustaining French brood stocks. The excellent success that NOAA-NMFS biologists have had (at the Northwest Fisheries Center's Aquaculture Experiment Station near Manchester, Wash., in culturing 2-year-old brood parents in total confinement in floating net-pens in Puget Sound indicates that this should be possible in France. This would give French biologists the capability of genetic control to develop stocks adapted to the Bretagne environment.

In 1973, the first coho cultured entirely in the freshwater hatchery reached maturity as 2-year-old fish, weighing from 0.3 to 0.8 kg. Approximately 100,000 eggs were taken from the females, but the quality was apparently similar to the eggs of the first brood stock cultured in the sea by NOAA-NMFS at their Manchester station. The eggs were transparent, with poor yolk dispersion and extremely fragile walls. The survival through hatching was only 1-3 percent, which is identical to the results of the NMFS first year brood.

The 2-year-old fish that did not mature were transferred to the diked tidal pond at Carpont in January 1974. Only 3 percent of these fish reached maturity as 1-2.5 kg females in late 1974 as 3 year olds. Approximately 17 percent of the population matured as males in a slightly smaller size range. Although a high proportion of these maturing fish were bright and did not exhibit the usual sexual characteristics of maturing coho cultured at Manchester, eggs could be extruded from the females, and ample quantities of seminal fluid from the males (Fig. 9). Unfortunatley, the eggs were found to be in the same conditions as those of the first spawning from the freshwater hatchery. In some cases, the female gonads were atrophied.

In December 1974, at Yvias, eggs were taken in fresh water from 2-year-old fish with better results (Fig. 10). About 20 percent of the eggs survived and the resulting progeny showed good growth. These fry were 6 weeks later in the development stage than those from U.S. coho eggs fertilized in early November and reared in the same French hatchery. But, by October 1975, the French progeny had caught up with the U.S. stock, reaching an average weight of 43 g (range 10-80 g).

CONCLUSIONS

Although the growth and survival of the coho salmon in fresh water in Bretagne is better than was anticipated, there are some problems in marine rearing. When the coho are adapted to seawater in the fall or winter, there is almost no mortality in the ensuing

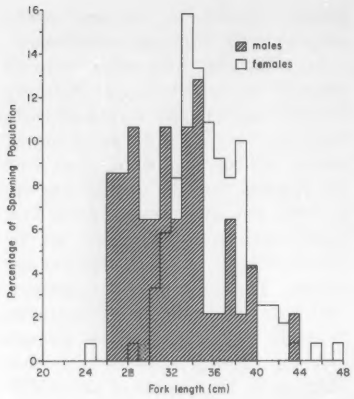


Figure 10.—Length-frequency distribution of 2-year-old coho spawning stock from the freshwater hatchery at Yvias (1972 brood). The weight range of these coho was approximately 300 to 800 grams.

months of culture, whereas normal smolts placed in seawater during the summer have high mortalities. It is possible that the combinations of high temperature and high salinity during the summer may induce an unacceptable stress, but these are factors which must be studied to determine the exact cause of these problems. Nutritional deficiency and bacterial infection cannot be overlooked as possible causes of mortality.

It is not known if the combination of high summer temperatures, high salinities and, in some cases, low dissolved oxygen levels are responsible for the poor results obtained with maturing females at Carpont in late 1974. The possible existence of nutritional deficiencies cannot, however, be excluded.

At present, a production cycle of holding coho in a freshwater hatchery until mid-fall and culturing in a sea for spring harvest appears to have the best advantages. This is a somewhat longer freshwater rearing period than in the United States, but the survival in the marine environment through marketing is high (95 percent). This slight disadvantage is almost negligible. Most recently, the CNEXO-NOAA team, working at the NMFS Manchester laboratory, found strong evidence of a possible pathogenic French vibrio. If further tests prove that this is true, the introduction of a French vibrio vaccination program similar to that developed by NMFS in Puget Sound might improve the summer rearing survival considerably[3] (Novotny, 1975 b).

Although the French production of sea-farmed coho salmon is less than 40 tons to date, it is nonetheless the first French-farmed salmon to appear on the market. Prices obtained by the SODAB growers were excellent, the product was of high quality, and the acceptance on the market was high. These favorable factors point to an established place for the coho salmon in the future of aquaculture in France.

LITERATURE CITED

Danioux, C., M. Girin, Y. Harache, and L. Laubier. 1975. L'Aquaculture Marine. (In three parts.) Grands Dossiers Alpha de la Mer 16 (176): 301-320; 17 (177):321-340; 18 (178):341-360. Grange Bateliere, Paris.

Harache, Y. 1974. L'aquaculture marine des salmonides. Penn Bed (Brest) 9(77):342-350.

Novotny, A. J. 1975a. Net-pen culture of Pacific salmon in marine waters. Mar. Fish. Rev. 37(1):36-47.

_____. 1975b. Preventative medicine: status of the legal use of vaccines. *In* T. Y. Nosho and E. L. Brannon (editors), Salmonid diseases: a workshop summary, April 17, 1974, p. 18-20. Univ. Wash. Sea Grant Prog., WSG-WO 75-2.

[3]National Marine Fisheries Service, Northwest Fisheries Center, Seattle, Wash., Monthly Report, Sept. 1974, p. 1-5.

MFR Paper 1194. From Marine Fisheries Review, *Vol. 38, No. 8, August 1976. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

MFR PAPER 1195

Bowhead Whale Field Studies in Alaska, 1975

Marquette

WILLMAN M. MARQUETTE

Willman M. Marquette is with the Marine Mammal Division, Northwest Fisheries Center, National Marine Fisheries Service, NOAA, Naval Support Activity, Building 192, Seattle, WA 98115.

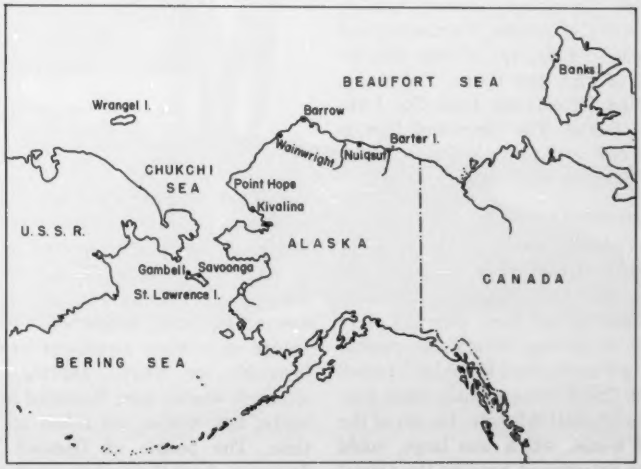
INTRODUCTION

The bowhead whale, *Balaena mysticetus*, is found in Arctic and northern subarctic waters. Its numbers were greatly reduced over a period of about 300 years, initially in the European Arctic, then in the eastern Canadian Arctic and the Okhotsk Sea. Commercial whaling for bowheads began in the Chukchi Sea and later in the Beaufort Sea during the mid-1800's; the last reported voyage occurred in 1916 (Bower and Aller, 1917) when the steamer *Herman* and the auxiliary whaling schooner *Belvedere* sailed north in the spring from San Francisco and Seattle, respectively, returning that autumn with some whale products. Some of the Arctic Alaskan trading companies continued to deal in whalebone for a few more years into the early 1920's. These animals have been completely protected from commercial whaling by the International Convention for the Regulation of Whaling since 1947, and subsequently, by the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973.

Two sections (Numbers 1 and 3) of the Schedule to the International Whaling Convention of 1946, revised 1975, are applicable to the harvest of bowhead whales by aborigines. Number 1 (1) includes *Balaena mysticetus*, the bowhead, in the definition of "right whale." Number 3 (b, c) classifies right whales as a Protection Stock which is defined as follows: "A Protection Stock is a stock which is below 10 percent of MSY stock level. There shall be no commercial whaling on species or stocks whilst they are classified as Protection Stocks." Number 3 (7) specifies that ". . . the taking of gray or right whales by aborigines or a Contracting Government on behalf of aborigines is permitted but only when the meat and products of such whales are to be used exclusively for local consumption by the aborigines." The MMPA (Sec. 101b) provides that any Indian, Aleut, or Eskimo "who dwells on the coast of the North Pacific Ocean or the Arctic Ocean" may take bowhead whales for subsistence or for the purpose of creating authentic articles of handicraft, if not accomplished in a wasteful manner. The ESA (Sec. 10, b, 3e) allows Alaskan Indians, Aleuts, and Eskimos the same privileges as does the MMPA. If, however, the taking of an endangered species affects it "materially and negatively," the ESA allows the Secretary (of Commerce) to prescribe protective regulations for that species.

The first studies on bowhead whales by a member of the staff of the Marine Mammal Division (MMD), then the Marine Mammal Biological Laboratory, were carried out by Dale W. Rice (1974) in 1961 and 1962. In 1973, through a contract with the University of Southern California, the National Marine Fisheries Service (NMFS), through the MMD of the Northwest Fisheries Center (NWFC), supported Floyd Durham's studies of the bowhead whale, which he had begun in 1961.

The principal objective of the current research is to determine the status of the bowhead whale stock of the Bering, Chukchi, and Beaufort seas. A biologist and several biological aids were stationed at the two most important whaling villages (Point Hope and Barrow) during the 1974 and 1975 spring whaling seasons. They visited the whaling camps as often as possible and gathered information on the number of bowheads sighted, killed and

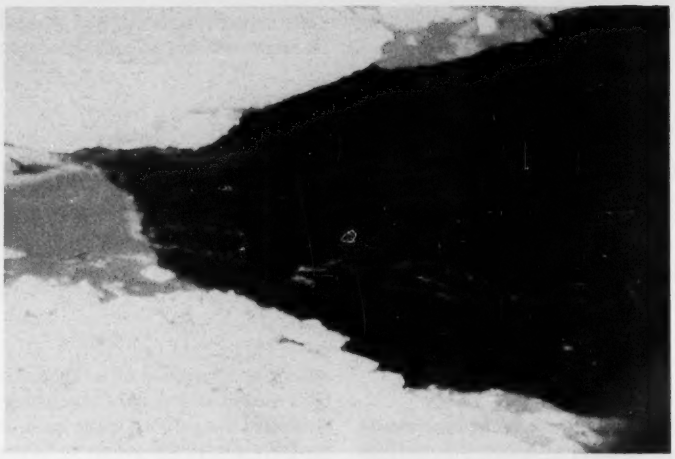


Map of bowhead whale study area.

recovered, and struck but subsequently lost. When a whale was taken, the biologists attempted to obtain measurements, collect specimen material, and take photographs. In addition, they made observations of whaling methods and equipment employed as a first step toward determining if it is possible to reduce the number of whales struck but not recovered.

The biologist and aids participating in the field work in 1975 were: Willman M. Marquette, Fisheries Biologist (Research), NMFS, NWFC, Marine Mammal Division; Geoffrey M. Carroll, John R. Patee, and Michael R. Busby, Biological Aids (Fisheries). Carroll, Patee, and Busby are students at the University of Alaska, Fairbanks.

Residents of the two St. Lawrence Island villages (Gambell and Savoonga), Kivalina, Point Hope, Wainwright, and Barrow engaged in spring whaling. Ice conditions east of Barrow do not permit spring whaling by residents of Nuiqsut or Barter Island (Kaktovik), however, these people participate in the autumn hunt as do the Barrow whalers. The locations of Alaskan whaling villages or areas are shown on the map.



Openings and large cracks, or leads, in the Arctic ice are utilized by the bowhead whale to migrate to and from summering and wintering areas.

Most of the bowhead whales taken by the Eskimos are pulled up onto the ice for butchering by means of blocks and tackle anchored to an ice bridge. All available men assist in hand pulling the whale up on the ice.

SPRING WHALING

Whaling Villages

We collected information at Point Hope and Barrow and indirectly learned of whaling activities at other villages from various sources. James A. Estes, U.S. Fish and Wildlife Service, Anchorage; Francis H. Fay, University of Alaska, Fairbanks; and Thomas J. Eley, Jr., Alaska Department of Fish and Game, Fairbanks, supplied information from St. Lawrence Island. The Reverend Clinton Swan of Kivalina provided information on whaling at that village.

St. Lawrence Island

The whaling season was begun on St. Lawrence Island about 25 April and ended on approximately 30 May. Nineteen crews from Gambell were active in whaling during this period. Two bowheads were killed by Gambell crews. One of these animals was a male 12.8 m (42 feet) in length; the sex of the other whale, which was large, could not be determined because the animal sank and was lost when the harpoon line parted. Whaling effort at Savoonga in 1975 was at least double that of 1974 (when two crews were reported actively whaling). Three additional whales were reported struck but lost off St. Lawrence Island. The bowhead whaling season ends when conditions become favorable for walrus hunting, and although whaling gear is carried in the boats, few whales are taken at this time. The people of Gambell and Savoonga share their whale catch each year.

Thomas Eley reported that during spring whaling at St. Lawrence Island, 15 bowhead whales were sighted on 7 May heading north, a few were seen on 9 May, and one was reported on 24 May about 48 km west of Gambell, also swimming north.

Kivalina

The period of whaling at Kivalina approximated that of Pt. Hope, although the exact dates are not known.

Five crews actively whaled at Kivalina during the spring of 1975. Whales were neither taken nor struck.

Point Hope

The whaling season was begun on 19 April and ended on 1 June when the ice became unsafe. NMFS observers were stationed in the village from 30 April until 3 June to monitor the harvest.

Thirteen whaling crews at Point Hope in 1975 killed four whales (Table 1) and biological information was collected by an NMFS observer from two. Two of the whales were young animals less than 8.5 m (27 feet 9 inches) in length and two were older animals estimated by the Eskimos to be about 11 m (36 feet) or more in length.

During the 1975 season 132 bowhead whales were sighted at Point Hope (Table 2), 128 by whaling crews or observers on the ice, and 4 from an aircraft that flew over open leads near Cape Lisburne, about 80 km north of the village. Bowheads taken by the whalers were included in the total and every effort was made to eliminate duplicate reports of sightings. Because other whales may have been seen by crew members and not reported, the 132 sightings represent a minimum number of bowheads seen at Point Hope.

Table 1.—Biological features of bowhead whales taken during spring 1975.

Area and date	Length (m)	Sex/Remarks
St. Lawrence Island—		
Gamble		
7 May	12.8	M
Point Hope		
24 April	[1]11.0	— Ingutuk[2]
26 April	[1] 6.0	—
10 May	8.5	F Ingutuk
15 May	[1]11.6	M
Barrow		
5 May	8.0	F
9 May	6.9	M
13 May	9.3	F
14 May	[1] 8.0	—
15 May	8.5	M
16 May	16.2	F
20 May	7.8	F
21 May	11.1	F
23 May	7.2	—
31 May	14.0	M Stinker[3]

[1] Estimate of length in feet was provided by the Eskimos.
[2] Some whales that are especially fat are designated as Ingutuk by the Eskimos.
[3] See text for description. Shot on 21 May but not recovered until 31 May.

Wainwright

Four whaling crews were active during the spring of 1975 at the village of Wainwright. Whales were not taken, and information was not received on whales that may have been struck but lost. The whaling period at Wainwright approximates that of Barrow.

Table 2.—Sightings of bowhead whales, spring 1975.

Date	Location	
	Point Hope	Barrow
April		
20-26	27	11
27	0	0
28	0	0
29	0	0
30	4	0
May		
1	0	0
2	2	0
3	0	0
4	0	0
5	0	3
6	1	1
7	0	15
8	0	0
9	7	3
10	22	1
11	1	0
12	0	0
13	0	3
14	18	1
15	2	8
16	12	6
17	15	0
18	3	3
19	2	0
20	1	1
21	0	3
22	0	0
23	0	6
24	4	0
25	1	0
26	5	0
27	[1]1	0
28	3	0
29	0	0
30	0	0
31	1	0
Total	132	83

[1] Two separate sightings, a pair (large whale with calf) and a single large whale.

An 11.1-m (36.4-foot) whale pulled up on the ice; butchering has just begun. Note the profile of the head which is a distinctive characteristic of the bowhead.

Barrow

The whaling season was begun on 21 April and ended on 4 June when the ice became unsafe for travel. Two observers were stationed at the Naval Arctic Research Laboratory (NARL), Barrow, from 22 April to 6 June, except for the period 30 April to 5 May when only one observer was present.

The number of whaling crews actively engaged in whaling varied almost daily, but approximately 30 crews were so occupied at Barrow some time during the season. Ten of eleven whales killed at Barrow during the spring season were recovered, and one was lost when it sank and broke the harpoon line. Some data were obtained on each of the butchered whales (Table 1). Length of the whales taken ranged from 6.0 to 16.2 m (19 feet 8 inches to 53 feet 2 inches). The last whale recovered at Barrow had been struck with a lance-bomb 21 May but it escaped and died and was recovered 31 May. Whales taken several days after death are called stinkers. The muktuk (skin and blubber), flukes, and baleen of a stinker can be salvaged but the remainder is discarded. Usually the crew that killed a stinker is identified by marks on the harpoon or bomb particles embedded in the whale and the crew that recovers the animal shares the carcass with the crew that killed it. Otherwise, a stinker belongs to the crew that recovered it.

Butchering of the whale has almost been completed. All portions of the whale are divided up among the crews that assisted in taking it, including the baleen that the workers are beginning to cut from the upper jaw. Note the 2.5-cm (1-inch) thick layer of black skin and the 17.2-cm (7-inch) layer of blubber.

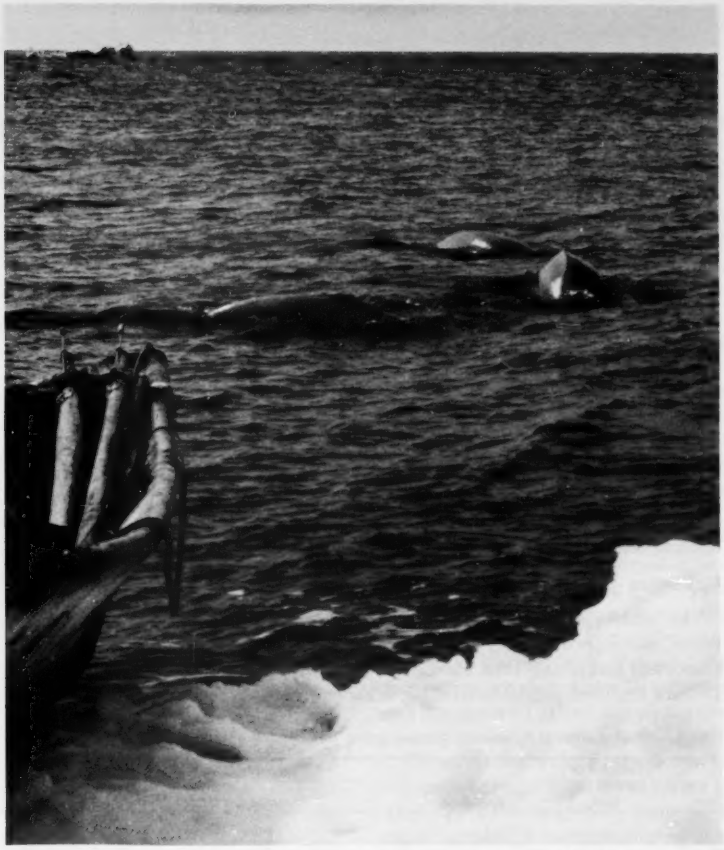
A seal-skin covered whaling boat (umiak) is being transported back from the edge of the lead because of incoming ice. The whaling crew's tent is always located on safe, land-fast ice. The black smoke coming from the stovepipe indicates that whale blubber is being burned for fuel.

Whaling Methods

The method presently used by Alaskan Eskimos to take whales has evolved from ancestral methods and the adoption of commercial whaling gear and methods introduced by Yankee whalers in the last century. VanStone (1958) has described the era of commercial bowhead whaling in Alaskan waters. The most recent description of the development of current Eskimo whaling methods is that of Durham (1974). VanStone (1962) described the traditional method of marking and cutting shares from a whale carcass at Point Hope, which, with some modification, is still in use there. A similar though much simplified method of marking and cutting shares from whales is used at Barrow. The three papers cited above provide background material on Alaskan bowhead whaling and the methods used to capture and cut up whales.

A detailed description of the whaling crews, whaling methods, and equipment employed in the fishery was presented in the report of the bowhead harvest in 1974 (Fiscus and Marquette, 1975[1]). Details on umiaks (skin boats) in use at Point Hope are given in Table 3. These boats averaged 6.9 m in

[1]Fiscus, C. H., and W. M. Marquette. 1975. National Marine Fisheries Service field studies relating to the bowhead whale harvest in Alaska, 1974. Natl. Mar. Fish. Serv., Northwest Fish. Cen., Seattle, Wash. Processed report, 23 p.



Belukha accompany bowheads on their spring migration and are frequently taken by the eskimos. Three belukha suddenly surfaced in front of a whaling crew and one was shot with a high-powered rifle.

length and 1.6 m in width (22 feet 6 inches by 5 feet 4 inches). Umiaks measured at Barrow in 1974 averaged 7 m in length and 1.7 m in width (23 feet by 5 feet 7 inches). Two of the skin boats used in 1975 at Point Hope were newly constructed and measured 6.4 and 6.8 m (20 feet 11 inches and 22 feet 4 inches) in length and 1.5 and 1.6 m (4 feet 10 inches and 5 feet 2 inches) in width. Some of the whaling captains stated that as the umiaks age they widen at the gunwales amidships. Whaling gear for the 13 crews at Point Hope is listed in Table 4.

At Point Hope only two individuals own heavy blocks and tackle capable of hauling whales out of the water onto the ice for butchering. Each set of this gear is valued at about $1,000. When this equipment is used to remove a whale from the water, the owner is entitled to a share of that animal. At least two individuals own blocks and tackle at Barrow.

The fact that a whale is struck and lost does not necessarily mean that it later dies. Some whales harpooned with the darting gun escape when the line breaks, and others hit with a missile from the shoulder gun escape if the bomb fails to explode. An unknown number of these animals may later die and some may recover. We have endeavored to collect data on all whales taken and on those struck but lost in an effort to obtain information related to mortality occurring as a result of the Eskimo harvest.

Several factors contribute to the problem of striking a whale and failure to recover it. In this respect, the effect of equipment used by the Eskimos to take whales was presented in the report for 1974. Another factor contributing to the struck but lost problem is increasing number of whalers. During the past few years, an increasing number of men have become financially able to purchase whaling gear, a factor that can be expected to cause an increase in the number of whales struck and lost.

Table 3.—Measurements of boats used by whaling crews at Point Hope, Alaska, spring 1975.

Length (m)	Width (m)	Remarks
7.20	1.56	Umiak
6.37	1.48	Umiak, new
7.20	1.75	Umiak
6.10	1.73	Umiak
4.90	1.61	Aluminum
6.80	1.57	Umiak, new
7.00	1.63	Umiak
7.39	1.68	Umiak
6.90	1.52	Umiak
6.95	1.65	Umiak
6.71	1.52	Umiak
7.35	1.63	Umiak
6.45	1.68	Umiak

Table 4.—Type of equipment used by whaling crews at Point Hope, spring 1975. Each horizontal line refers to the equipment of one crew.

Boats				Darting gun		Floats				
Umiak	Metal	Outboard motor	Shoulder gun	With harpoon	Without harpoon	Large plastic	Small plastic	Sealskin	Cross-bow	Har-poon
1	—	—	2	1	—	1	1	—	—	—
1	—	—	—	1	1	1	1	—	—	—
1	—	1	2	1	—	1	1	1	—	—
1	—	1	2	1	—	1	1	—	—	—
—	1	—	—	1	1	1	1	—	—	—
1	—	—	—	1	[1] 1	1	1	1	—	—
1	—	—	[2] 2	1	2	1	1	—	1	—
1	—	1	2	1	1	1	1	—	—	1
1	—	—	1	1	1	1	1	—	—	—
1	—	—	1	1	—	1	1	—	—	—
1	—	1	—	1	1	1	1	—	—	—
1	—	—	1	1	1	1	1	—	—	—
1	—	1	—	1	1	1	1	1	—	—
12	1	5	13	13	10	13	13	3	1	1

[1] Lost overboard from umiak at beginning of season.
[2] Both lost through young ice at beginning of season.

Fewer whales were reported struck and lost at Barrow than at Point Hope in 1975. One of eleven bowheads killed by Barrow crews sank and could not be recovered. An incomplete count indicated a minimum of 10 animals struck and lost. Point Hope crews killed 4 whales and struck but lost 13. The point Hope data are considered reasonably complete, whereas that for Barrow is incomplete.

A whaling crew towing a dead belukha to their camp site where it will be butchered.

Whaling Effort

The number of crews engaged in bowhead whaling increased in 1975 compared to those that were active in 1974. The number of crews increased from 10 to 13 at Point Hope, and from 21 to 30 at Barrow. Our observations at Barrow have shown that although a large number of crews may be outfitted with whaling gear, the number that actively engage in whaling throughout the season is significantly smaller. Reports received from scientists who visited St. Lawrence Island indicate that eight crews were observed whaling there in 1974 compared to 23 crews in 1975. The information on whaling activities in 1974, however, was obtained after the season had ended and may not be as complete as the data obtained throughout most of the season in 1975. Further study is needed, therefore, before any trend in the whaling activity off St. Lawrence Island can be established.

The number of crews hunting at the lead (a channel of water through a field of ice) varied during the season. In an attempt to evaluate hunting effort, we maintained a record of crew activities throughout the season (Tables 5, 6). In 1975, Point Hope crews were at the lead 27 days (81.8 percent of the time) from 30 April to 1 June. At Barrow, crews were at the lead 37 days (86.0 percent of the time) from 22 April to 3 June. Whalers return to shore or to fast ice when leads close or the ice becomes unsafe.

Although the number of crews engaged in whaling in the spring of 1975 at Barrow was large, the number that actively engaged in whaling at every opportunity throughout the season averaged close to 14. A daily count of active crews was not obtained because their camps were scattered along some 40 km of lead and not all could be reached during a single day. The whaling season lasted about a month and a half at Point Hope and Barrow with the most productive hunting occurring during May.

Utilization

The whales were pulled from the water when possible by means of blocks and tackle and then butchered. Thin ice required partial butchering of the animal before it could be hauled from the water, a situation that greatly increased the time spent on this aspect of whaling. Accordingly, the butchering process required from as few as 3 to as many as 30 hours. Parts removed from the animal were taken ashore as soon as possible to prevent their loss when the ice shifted.

Most meat and muktuk were removed from the butchering site immediately after the whale was cut up.

Table 5.—Whaling effort at Point Hope, Alaska, spring 1975.

Date	Number of crews on lead	Remarks
April		
30	5	Lead open, strong north wind, water rough.
May		
1	2	Lead open, all crews went out in evening when wind subsided.
2	13	Lead open and very wide.
3	9	Lead open but all crews went ashore at end of day as wind continued strong, ice not safe.
4	0	Lead open, miles wide, windy but too rough to whale.
5	8	Lead open, crews began going out at noon, at 1800 hours eight crews were out.
6	5	Lead closing, south wind.
7	8	Lead closed.
8	11	Lead closed.
9	11	Lead opening on west end.
10	11	Lead open, getting wide.
11	13	Lead open.
12	13	Lead closed at noon by current.
13	11	Lead open.
14	13	Lead open.
15	7	Lead open, but windy and rough.
16	6	Lead open, but windy and rough.
17	4	Lead open, windy and rough.
18	2	Lead open, windy and rough.
19	2	Lead closed.
20	12	Lead open.
21	13	Lead open, three crews off ice at evening.
22	12	Lead open, one crew went out in morning, two in afternoon.
23	0	Lead began closing 0800 hours, closed by noon.
24	0	Lead closed.
25	7	Lead opening on west end.
26	12	Lead open, one crew off ice in evening.
27	12	Lead open, two crews off ice in afternoon.
28	0	Lead open but ice dangerous because of current.
29	0	Lead open, ice dangerous.
30	2	Lead open, ice dangerous.
31	5	Lead open, two crews out in morning, one out at 1600 hours, two out at 1900 hours.
June		
1	0	Lead open but ice dangerous, three crews off ice at noon, two off at 1700 hours, season had ended.

Occasionally, however, several days elapsed before all parties hauled off their shares. Remains of the backbone, some ribs and internal organs, and the skull (at Barrow) were generally left on the site. Usually, fewer parts of the whale were left on the ice at Point Hope than at Barrow. At Point Hope, the skull was returned to the sea after the tympanic bullae and lower jawbones were removed, and the latter taken to the village for use during the spring whale feast. At Barrow, the skull (tympanic bullae removed), including jawbones, was usually left at the butchering site. At some butchering sites, mostly at Barrow, blubber was left on the ice. Before the snowmobile era, surplus blubber was used for dog feed. The Eskimo utilizes the meat, muktuk, baleen, gum tissue (mamaak), flukes, flippers, brains, tongue, intestines, heart, kidneys, epithelium of the liver, and the tympanic bullae.

Table 6.—Whaling effort and weather data at Barrow, Alaska, spring 1975.

Date	No. of crews on lead	Aver. temp. (°F)	Average wind velocity (mph)	Wind direction (°)
April				
22	2	12	10.0	280
23	4	5	13.0	270
24	5	−5	9.0	220
25	5	−3	17.0	050
26	15	5	17.0	010
27	15	7	10.0	330
28	6	7	6.0	150
29	3	4	10.0	230
30	[1]0	−1	10.0	230
May				
1	0	6	11.4	050
2	19	9	12.4	070
3	21	15	13.6	070
4	21	21	12.9	070
5	21	21	10.0	190
6	22	17	5.5	190
7	23	15	6.6	070
8	20	23	—	130
9	21	22	8.3	070
10	21	24	14.9	070
11	[1]0	27	22.1	060
12	[2]4	16	18.9	080
13	18	15	18.0	080
14	19	17	13.4	090
15	20	14	10.2	040
16	17	20	10.3	300
17	12	15	5.6	340
18	17	18	5.7	040
19	17	19	—	270
20	17	16	10.2	100
21	17	17	10.5	080
22	17	16	6.1	060
23	[3]17	15	8.4	110
24	[4]12	15	11.6	120
25	15	19	6.2	080
26	0	20	17.8	070
27	0	—	—	—
28	5	—	—	—
29	11	—	—	—
30	10	—	—	—
31	10	—	—	—
June				
1	7	—	—	—
2	0	—	—	—
3	[4]3	—	—	—
4	0	—	—	—
5	0	—	—	—
6	0	—	—	—

[1]Lead closed.
[2]Strong winds, crews moved back to safe ice.
[3]Lead partly closed.
[4]Crews out in the morning, back off ice in evening

Migration

The Eskimos of Point Hope and Barrow recognize three distinct runs of whales past their villages. Whales making up the first two runs are usually small animals of both sexes, and many of them are the size that Durham[2] would call yearlings. Durham reports that yearling bowhead whales range in length from 6.7 to 7.9 m (22 to 26 feet). Whales making up the third run include large males and females with calves. According to Durham[3] as many as four runs (or waves) of bowheads occur; the first run passes Point Hope in early April and Barrow in late April, which in some years may pass unnoticed due to ice conditions that prevent the whalers from going out; two runs pass Barrow in May; and the fourth run, which includes large males and females with calves, passes Barrow in early June.

Three distinct runs of the bowhead occurred at Point Hope in the spring of 1974. In 1975, only two runs were noted, probably because during late May several open leads existed far offshore from Point Hope, within which the whales may have traveled instead of migrating through the nearshore lead. The first run occurred 20-30 April and the second 10-17 May. Two distinct runs were all that were observed at Barrow this spring, but as at Point Hope additonal runs could have moved through large open leads far offshore.

The above data are weak and more information must be gathered on migration waves before definite conclusions can be drawn. Certainly, the bowhead is dependent on leads or recently fractured ice containing thin spots through which it can surface for air. Leads far offshore obviously allow whales to migrate unobserved.

Many species of marine mammals migrate in series of waves from wintering to summering grounds. Rice and Wolman (1971) described the seasonal migratory cycle of the gray whale, *Eschrichtius robustus*, which exhibits temporal segretation by age, sex, and reproductive status. Similar segregation has been reported among humpback whales, *Megaptera novaeangliae*, by Dawbin (1966).

Other Mammals and Birds

In addition to bowhead whales the following species of mammals were observed or reported in 1975 at Point Hope during the spring whaling season:

Belukha	*Delphinapterus leucas*
Bearded seal	*Eringnathus barbatus*
Polar Bear	*Ursus maritimus*
Ringed seal	*Phoca hispida*
Walrus	*Odobenus rosmarus*
Wolverine	*Gulo luscus*

Although belukha were occasionally observed from 30 April to 1 June, three noticeable waves of these animals migrated past Point Hope whaling camps—the first prior to 30 April, the second 10-15 May, and a third from 22 to 26 May. Belukha sighted and taken at Point Hope are given in Table 7. The Eskimos at Point Hope did not actively pursue belukha during the bowhead whaling season because they sink quickly and require considerable effort to recover, although they are prized for food. A belukha harvest at this time is

Table 7.—Belukha taken and sighted at Point Hope, Alaska, spring 1975.

Date	No. sighted	No. taken	Remarks
Prior to 30 April	1	1	
30 April	100	0	Observed from aircraft over leads off Cape Lisburne.
Prior to 2 May	[1]1	0	
May			
2	7	7	One was female with fetus.
10	25	0	
13	30	0	
14	20	0	
15	11	0	
22	15	0	
23	12	0	
26	15	[1]2	
27	7	3	A 3.15-m female was taken, but not calf with it.
Total	244	13	

[1]All following observations made from ice edge of lead.

[2]Durham, F. E. 1972. Biology of the bowhead whale (*Balaena mysticetus* L.) in the western Arctic. University of Southern California, Los Angeles, Calif. Unpubl. manuscr.

[3]Durham, F. E. 1973. Census and spring migration studies on the bowhead whale in the western Arctic in 1973. National Marine Fisheries Service, Seattle, Wash. Unpubl. manuscr.

incidental to the bowhead whale fishery. Rifles are normally used to kill the animals. It is difficult to obtain data on the belukha because these animals are butchered immediately after they are killed, a process that requires but a few minutes to complete after the animal is hauled onto the ice. Crew members at times eat some of the meat at the whaling camp, but usually take their shares directly home. Measurements were obtained of a lactating female killed 27 May, but her calf was not taken. The technique used to butcher these animals at Point Hope is illustrated in an accompanying photograph.

Other species killed at the Point Hope lead during the spring whaling season were 17 ringed seals (including two juveniles), one walrus, three polar bears, and two wolverines (Table 8). In addition, one ringed seal and two bearded seals were sighted.

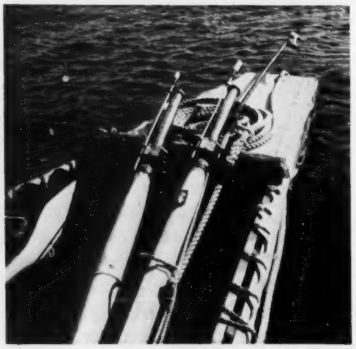
Eider ducks, initially the king eider, *Somateria spectablis*, and later the Pacific eider, *S. molissima v-nigra*, began to pass up the lead in considerable numbers beginning about 8 May and were regularly taken at the camps, especially when the lead was closed or strong winds made whaling impractical. King and Pacific eider ducks are abundant at Barrow and are taken in numbers throughout their migratory period by the whalers.

Other mammals killed at Barrow included 17 ringed seals and one polar bear. In addition, sightings of 10 ringed seals were recorded. Reports were not received of belukha or walrus being seen or taken during our stay at Barrow.

As soon as the belukha has been pulled up on the ice, it is butchered and divided up among the members of the whaling crew.

Table 8.—Mammal species other than whales taken or observed at Point Hope, Alaska, spring 1975.

Species	Date	No. seen	No. taken	Remarks
Ringed seal	2 May	1	1	
	Prior to 8 May	2	2	
	8 May	1	1	
	16 May	1	1	
	19 May	1	1	Male, 129 cm
	19 May	2	2	
	19 May	1	0	
	20 May	2	2	
	21 May	2	2	
	25 May	1	1	Male, 104 cm
	28 May	1	1	
	28 May	1	1	Juvenile
	28 May	1	1	Juvenile
	28 May	1	1	Male, 98 cm
Bearded seal	13 May	1	0	
	19 May	1	0	
Walrus	20-26 April	1	1	Large bull
Polar bear	20-26 April	1	1	
	6 May	1	1	
Wolverine	20-26 April	1	1	
	6 May	1	1	



Two darting guns in position in the bow of the skin boat. One gun has a harpoon rigged. When a whale is sighted the crew launches and gets as close to the whale as possible. The darting gun with harpoon is driven into the whale's back as close to the head as possible. When the white-tipped rod, to the left of the muzzle, touches the whale it fires a bomb into the whale, which if placed properly may kill the whale instantly. The harpoon, to the right of the muzzle, remains in the whale and is attached to a float by a line about 61-m (200 feet) in length.

AUTUMN WHALING

Only one crew actively whaled at Barrow in the autumn. A camp was maintained at Point Barrow from 17 to 25 September. Whaling during most of

Two shoulder guns have been placed so that they can be easily picked up. The bomb has been removed from the gun in the foreground to show its size. After the darting gun has been fired into the whale and the harpoon attached, a shoulder gun may be used to finish off the whale.

this period was impossible because of severe ice conditions. The crew sighted one bowhead on 17 September and killed a 2-year-old polar bear on 25 September. Two crews whaled at Kaktovik, Barter Island, but whales were not taken. One small bowhead was seen at the beginning of the season, which began about 7 September. One crew from Nuiqsut was reported to be whaling, but whales were not sighted.

SUMMARY

During the spring of 1975, 15 bowheads were caught, 2 were killed but lost, and 26 were struck but lost. No bowheads were taken in the autumn of 1975 (see Table 9).

Table 9.—Number of bowheads taken, known killed but lost, and known struck but lost in 1975.

Location	Season	Bowheads butchered	Killed but lost	Struck but lost
Gambell	Spring	1	1	3
Savoonga	Spring	0	0	0
Kivalina	Spring	0	0	0
Pt. Hope	Spring	4	0	13
Wainwright	Spring	—	—	—
Barrow	Spring	10	1	10
Barrow	Autumn	0	0	0
Nuiqsut	Autumn	0	0	0
Kaktovik	Autumn	0	0	0
Total		15	2	26

ACKNOWLEDGMENTS

The support of the Naval Arctic Research Laboratory, Barrow, Alaska, is gratefully acknowledged. The use of the NARL cabin at Point Hope and logistic support made it possible for us to observe and collect information on whaling in that area. The use of NARL facilities and the expertise of the staff at Barrow were essential for our studies there. Clifford H. Fiscus supervised the project and reviewed the manuscript.

[*]Harry Reynolds, Alaska Department of Fish and Game, Barrow, determined the age of the polar bear.

A jumbled mass of recently shifted ice pressed against the landfast ice. The phenomenon known as water sky is plainly visible above the open water of the lead.

When a whale is captured, 50 to 60 people will come out on the ice to help haul it out and cut it up. Early in the season when the first whales are taken, several hundred people may come to the butchering area, especially if it is close to a village.

LITERATURE CITED

Bower, W. T., and H. D. Aller. 1917. Alaska fisheries and fur industries in 1916. Rep. U.S. Comm. Fish., 1916, Append. II, 118 p., (Doc. 838).

Dawbin, W. H. 1966. The seasonal migratory cycle of humpback whales. *In* K. S. Norris (editor), Whales, dolphins, and porpoises, p. 145-170. Univ. Calif. Press, Berkeley.

Durham, F. E. 1974. Ancient and current methods of taking the bowhead whale. Univ. Alaska Sea Grant Prog., Anchorage, Alaska, Sea Grant Rep. 73-9, 15 p.

Rice, D. W. 1974. Whales and whale research in the eastern North Pacific. *In* W. E. Scheville (editor), The whale problem: a status report, p. 170-195. Harvard Univ. Press, Camb., Mass.

Rice, D. W., and A. A. Wolman. 1971. The life history and ecology of the gray whale (*Eschrichtius robustus*). Am. Soc. Mammal., Spec. Publ. 3, 142 p.

VanStone, J. W. 1958. Commercial whaling in the Arctic Ocean. Pac. Northwest Q. 49:1-10.

_____ . 1962. Point Hope. An Eskimo village in transition. Univ. Wash. Press., Seattle, 177 p.

MFR Paper 1195. From Marine Fisheries Review, *Vol. 38, No. 8, August 1976. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

MFR PAPER 1196

Utilization of the Bowhead Whale

GEOFFRY M. CARROLL

Carroll

Geoffry M. Carroll is with the Marine Mammal Division, National Marine Fisheries Service, NOAA, Naval Support Activity, Building 192, Seattle, WA 98115.

INTRODUCTION

The hunting of bowhead whales has been a very important part of Eskimo life since before 1800 B.C. (Oswalt, 1967). Prior to the introduction of manufactured products to these people by commercial whalers and traders, the entire whale was used in one form or another to make tools, weapons, homes, and toys. With the passage of time, however, whale products have gradually been replaced by manufactured goods. This paper describes how the use of various whale parts has changed through the years.

FOOD

The most important parts of the whale have always been the meat and muktuk (layer of blubber with skin attached). Together, the meat and muktuk provide a large percentage of the food supply for the Eskimos of several whaling villages during a successful whaling year. The meat is a major source of protein and B vitamins, and the muktuk provides vitamins D and A and calories which are needed in large quantities to stay warm in the Arctic (Davidson, 1972). Both parts are eaten raw, frozen, boiled, or fried. The meat is sometimes made into "mekiqag" by placing it in a warm place and slow-cooking it in its own juices for a few weeks (Anonymous, 1967). This product is always served at whaling celebrations. Whale meat and muktuk are used in trading and are highly prized by Eskimos all over northern Alaska and Canada (Anonymous, 1967). An estimated 10,000 Eskimos and Indians outside the whaling communities supplement their diet with whale meat (Davidson, 1972).

Other edible parts of the bowhead whale are the liver, brain, heart, and kidney. The small intestine is turned inside out, cleaned, and eaten during the spring whaling celebration; the white gum material from around the base of the baleen is eaten raw; and clumps of blood from around the heart are sometimes consumed, but usually fed to the dogs (Robert Brower, pers. commun.).

Less desirable whale parts were once a very important source of dog food. Each dog consumed about 800 pounds of meat annually (Foote, 1965), so a great deal of hunting effort was required to maintain a team of sled dogs. A successful whaling season solved the problem for most of the year, but because snow machines have largely replaced the dog teams, much less meat and blubber are now used for animal food.

HEAT AND LIGHT

Blubber has been traditionally rendered into oil through autolysis, by cutting it into small pieces, scoring it with a knife, and putting it into barrels (Davidson, 1972). The oil was used mostly as a fuel in soapstone and sandstone lamps with sphagnum moss wicks to heat and light igloos (Murdoch, 1885). It was also used as a dip for foods (Nelson, 1889), cooking oil (Anonymous, 1968), and, when mixed with red ochre, as a dye (Oswalt, 1967). Because of its value as a fuel, whale and seal oil were also used by coastal Eskimos to barter with inland people for caribou and wolverine skins (Oswalt, 1967).

COMMERCIAL PRODUCTS

During the commercial whaling period, blubber was rendered into oil by heating and sold for use in lamps, for tanning leather and preparing wool cloth, and for manufacturing soap, candles, paints, varnishes, and lubrication oils (VanStone, 1958). One large bowhead whale yields up to 275 barrels of oil (Scammon, 1874).

Baleen, now used in artwork, has lost its importance as a raw material for the making of practical items. Its qualities of flexibility and formability once allowed it to be used in an almost endless variety of ways.

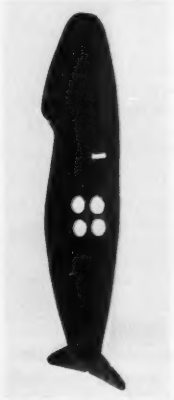
During the period of commercial whaling, the taking of baleen to be processed into corset stays, buttons, parasols, umbrellas, women's hats, upholstery, frameworks for trunks and suitcases, fishing rods, buggy whips, and carriage wheels and springs was a profitable business (VanStone, 1958). Each whale contained several hundred pounds of baleen, which sold for $2 per pound in 1880 and $4.90 per pound in

Workbox, 6.25 inches long, from Southwest Cape, St. Lawrence Island, has sides made of baleen. Photo courtesy of the University of Alaska Museum, Fairbanks.

1905, making a large whale worth up to $10,000. Values such as these led to an increase in the number of whalers and a corresponding reduction in the number of whales. In 1885, 441,400 pounds of baleen from the Arctic were marketed, and in 1887 and 1889, 561,694 and 219,400 pounds, respectively, were sold. By 1905, only 38,200 pounds were taken despite a price of nearly $5 per pound (VanStone, 1962). Baleen was replaced by other products shortly thereafter and the market was eliminated.

ESKIMO IMPLEMENTS

The Eskimos cut baleen into strips, then braided and tied them into lines (Murdoch, 1885) which remained strong through prolonged use in salt water (Davidson, 1972). Because of this strength, baleen was a good material for fishlines (Oswalt, 1967) and boat and sled lashings (Ray, 1885). Baleen strips were also woven around the prongs of a caribou antler to make a scoop for removing ice from ice fishing holes (Murdoch, 1885). Baleen lines were used to make gill nets for catching whitefish (Oswalt, 1967), to tie sinkers onto the nets (Naval Arctic Research Laboratory Museum display), to hold the mouth of dip nets open (Nelson, 1969), and as a mesh and support for crab traps (Oswalt, 1967).



Toy whale (above) from Gambell, St. Lawrence Island, is a model of a bowhead whale used by small boys for target practice. Photo courtesy of the University of Alaska Museum, Fairbanks.

Net shuttle 10.25 inches long (left), from Barrow, Alaska, was used for weaving nets. Photo courtesy of the University of Alaska Museum, Fairbanks.

Baleen was also used to make containers. Cups, dishes, and dippers were made by bending baleen around a wooden base, and buckets were made by sewing overlapping pieces of baleen together to make the sides (Murdoch, 1885).

Walking sticks had baskets like those on ski poles which were made of strips of baleen wrapped so as to form a circle (Naval Arctic Research Laboratory Museum display). Sleds, made by sewing several pieces of baleen together side by side, were easily carried while hunting and were used to drag seals or materials back to the village (Bandi, 1969). Sleds of this type are still used on St. Lawrence Island.

Baleen had many practical uses, such as knife blades for cutting blubber (Murdoch, 1885), rivets in many implements such as shovels, knives, picks, and harpoons (Murdoch, 1885), and as insoles in shoes (Oswalt, 1967). Strips of baleen were also used to hold the lids on boxes (Murdoch, 1885), and windows were made of the translucent membrane of seal entrail stretched by a piece of baleen (Murdoch, 1885).

Whalebone was also used extensively because it is strong and easily workable (Oswalt, 1967). The ribs of young whales, particularly ingutuks, made good, versatile sled runners because of their hardness and lack of pitting peculiar to the ribs of older whales. Sled runners made of whale ribs slid easily over tundra, ice, or snow (Sonnenfeld, 1956). Jawbones have been used as sled runners (Ray, 1885) and also as umiak keels to prevent wear while these boats are being dragged over the ice during spring whaling (Sonnenfeld, 1956). The jawbones and ribs were used as frames in building sod igloos (Sonnenfeld, 1956).

Whalebones were used in making the heads of mauls, handles for knives, the foreshafts of darts thrown with a darting board, the handles and blades of an adze, the blade of flint flakers, shafts of flensing knives, sinew shuttles, weaving tools, needle cases, pipe bowls, water ladles, braces to protect the arm from the snap of a bow string, and net weights.

Hand clubs were made from a short blunt piece of bone, and a piece of whale rib lashed to a shaft made a mattock. The handle and blade of an adze could be made from whalebone, and the scapula or shoulder blade was used to make snow shovels (Murdoch, 1885). Harpoon heads were sometimes made from whalebones (Larsen and Rainey, 1940). In Point Hope, jawbones were used to support burial scaffolds (Davidson, 1972) and to form a palisade around the cemetery.

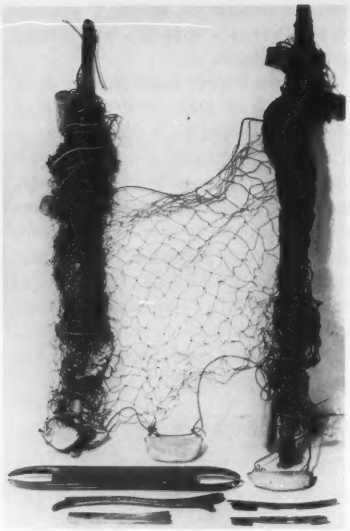
ANIMAL TRAPS AND SPEARS

The flexibility of baleen was a quality useful for taking wolves and bears. Spring-baits were made by sharpening both ends of a 6-inch piece of baleen, wetting it, and then tying it, folded into lengths of 1.5-2 inches until dry. The baleen was then placed inside a piece of fish skin or blubber, and after an animal had injested it, the moisture and body heat caused the folded baleen to straighten and pierce the stomach wall (Murdoch, 1885).

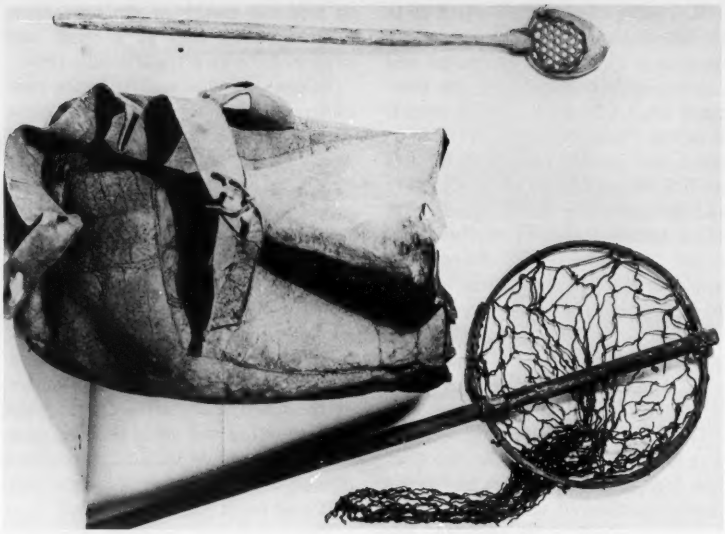
Nooses made of baleen were used to trap ground squirrels as they passed through their tunnels (Nelson, 1889) and also birds when they returned to their nests (Murdoch, 1885).

Fox traps were made by placing pieces of baleen over holes in the ice or snow and covering them with snow. Bait was placed on one side and a drift fence constructed so that the fox had to pass over the trap. In doing so, the fox fell through and was impaled on caribou antlers that had been placed in the bottom of the hole. In another version of this trap, strips of baleen were placed on the ice with their ends radiating inward to cover a large hole. When the fox fell through, the baleen snapped back into position and the trap was automatically readied for another animal (Nelson, 1969).

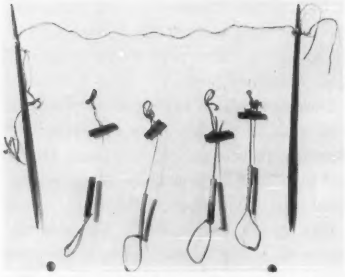
Baleen prongs with spurs on them were attached to the tips of fish spears so that when the sharp middle prong entered the fish, the flexible baleen pieces slid by, and the spurs became extended and kept the fish from sliding off (Murdoch, 1885). Bow shafts were sometimes made with baleen (Bandi, 1969).



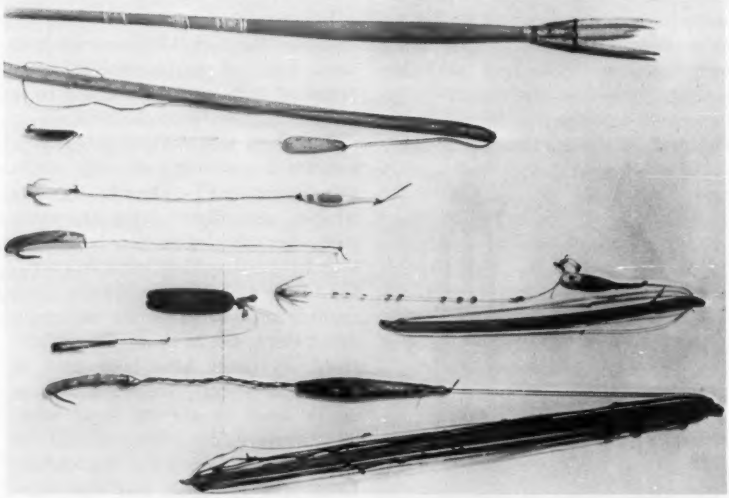
Gill net made with whale bone sinkers. Photo from the Van Valin Collection, courtesy of the University of Alaska Archives, Fairbanks.



When fishing through the ice, this slush scoop is used to prevent the hole from freezing over by dipping out the constantly forming slush. The strainer bottom is made of whalebone, to which ice does not readily cling. Photo from the Van Valin Collection, courtesy of the University of Alaska Archives, Fairbanks.

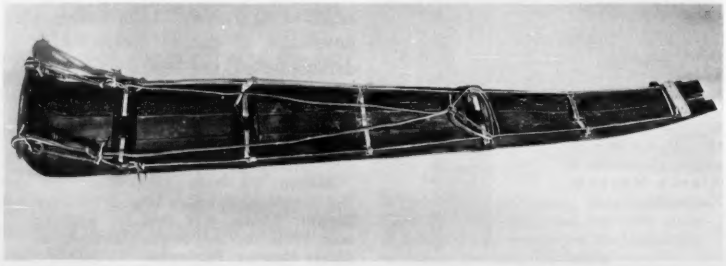


Snare nooses of whalebone used to catch ermine and ground squirrels (Marmots). Photo from the Van Valin Collection, courtesy of the University of Alaska Archives, Fairbanks.



Fishing lines made of whalebone. Photo from the Van Valin Collection, courtesy of the University of Alaska Archives, Fairbanks.

"Death pills," used to help kill polar bears, are made of baleen strips sharpened at both ends and folded or wound like a clock. After being eaten, the "pills" open to pierce the stomach wall. Photo from the Van Valin Collection, courtesy of the University of Alaska Archives, Fairbanks.



Baleen sled, 73 inches long, (right) from Gambell, St. Lawrence Island, is used for hauling meat. Photo courtesy of the University of Alaska Museum, Fairbanks.

TOYS

Many toys were made from baleen because of its flexibility. A marionette made from a fox skin supported by a piece of baleen down the back was worked with strings so that it would dart its head at a toy lemming (Murdoch, 1885). Baleen was also used to make a doll's arms so that when pushed, this toy would beat a drum or paddle a canoe (Murdoch, 1885). In addition, baleen was used to make a device used by boys to snap pebbles at targets and to sew liver membrane onto drums (Murdoch, 1885).

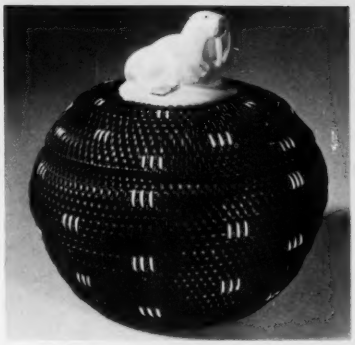
ARTS AND CRAFTS

Baleen is now used almost exclusively in arts and crafts. Bracelets, baskets, miniature boots, sleds, and baleen etchings are most frequently made. Baleen is also used as inlay material in ivory, whalebone, and driftwood art objects (Davidson, 1972). The price of these items is rising rapidly. In 1974, a 5-inch high baleen basket with an ivory carving attached sold for $80-$120. In 1975 it brought $150-$200. Whalebone is now used in making such art objects as bears, birds, whales, and seals, and artifacts are often reproduced from this material.

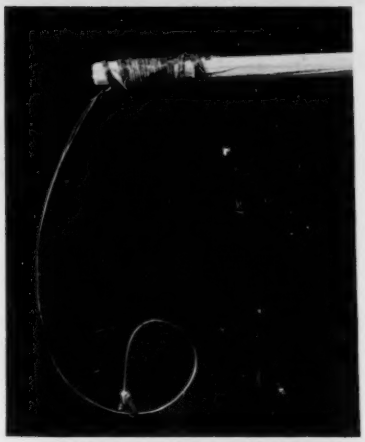
SUMMARY

The bowhead whales' value as food has not changed, even though a wide variety of domestic meat is now available to the Eskimo. As manufactured goods more convenient to use have become increasingly abundant in the Arctic, however, traditional uses of the bowhead whale have disappeared. Bone has been replaced by metals, baleen by rope and plastics. Driftwood, petroleum products, electricity, and (at Barrow) natural gas have replaced whale oil as heating fuels. Blubber is occasionally burned in camp stoves and ceremonial fires (Ed Wightman, pers. commun.) and is still used in whaling tent fires at Point Hope. In 1950, the people of Point Hope sent 40 drums of whale oil to Seattle in an attempt to develop a market for the product, but to no avail (VanStone, 1962.)

Other sources of information on this subject include: "The Eskimos" by K. Birket-Smith, published by Metheun and Company, Ltd., London, in 1959; "Eskimo" by E. Carpenter, F. Varleur, and R. Flaherty, published by the University of Toronto Press, Toronto, in 1959; and "The North Alaskan Eskimo. A study in ecology and society" by R. F. Spencer, Bulletin 171 of the Smithsonian Institution's Bureau of American Ethnology (1959).



Basket 5.5 inches high, made by Abe Simmonds of Barrow, Alaska, is coiled with dark and light baleen from the bowhead whale. Photo courtesy of the University of Alaska Museum, Fairbanks.



Baleen mouse snare from Gambell, St. Lawrence Island. Photo courtesy of the University of Alaska Museum, Fairbanks.

LITERATURE CITED

Anonymous. 1967. Amos Lane catches whale at Point Hope. Tundra Times, June 2, p. 1, 6.

Bandi, H. -G. 1969. Eskimo prehistory. Univ. Alaska Press. Distrib. Univ. Wash. Press, Seattle, 226 p.

Davidson, A. 1972. Eskimo hunting of bowhead whales. Rural Alaska Community Action Program, Anchorage, 37 p.

Foote, D. C. 1965. Exploration and resource utilization in northwestern Arctic Alaska before 1850. Ph.D. Thesis, McGill Univ., Montreal, Quebec, 128 p.

Larsen, H., and F. Rainey. 1948. Ipiutak and the arctic whale hunting culture. Antoropol. Pap. Am. Mus. Nat. Hist. 42:1-276.

Murdoch, J. 1885. Mammals. *In* P. H. Ray, Report of the International Polar Expedition to Point Barrow, Alaska, p. 92-103. 48th Cong., 2d sess., House of Rep., Ex. Doc. 44.

Nelson, E. W. 1899. The Eskimo about Bering Strait. *In* U.S. Bur. Ethnol. 18th Annu. Rep., p. 19-518. U.S. Gov. Print. Off., Wash., D.C.

Nelson, R. K. 1969. Hunters of the northern ice. Univ. Chicago Press, Chicago, 429 p.

Oswalt, W. H. 1967. Alaskan Eskimos. Chandler Publ. Co., San Franc., 297 p.

Ray, P. H. 1885. Report of the International Polar Expedition to Point Barrow, Alaska. 48th Cong., 2d sess., House of Rep., Ex. Doc. 44, 695 p.

Scammon, C. M. 1874. The marine mammals of the northwestern coast of North America, described and illustrated: together with an account of the American whale-fishery. John H. Carmany and Co., San Franc. Reprinted by Dover Publications, N.Y., 1968, 319 p.

Sonnenfeld, J. 1956. Changes in subsistence among Barrow Eskimos. Ms., Proj. ONR-140 for AINA, 589 p. Nav. Arct. Res. Lab., Barrow, Alaska.

VanStone, J. W. 1958. Commercial whaling in the Arctic Ocean. Pac. Northwest Q. 49: 1-10.

_____ . 1962. Point Hope. An Eskimo village in transition. Univ. Wash. Press, Seattle, 177 p.

MFR Paper 1196. From Marine Fisheries Review, *Vol. 38, No. 8, August 1976. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

MFR PAPER 1197

Resource Ecology Data Analysis at the Northwest Fisheries Center (NWFC)

F. FAVORITE, D. J. BROWN,
and W. J. INGRAHAM, Jr.

INTRODUCTION

Although few people doubt that living marine organisms are affected by the marine environment, the enormous tasks associated with not only the initial measurement, but the subsequent analysis of the three-dimensional spatial fields have proved to be a major deterrent in acquiring the amount of environmental data required to provide insight into specific relationships. In the 1950's and 1960's the Bureau of Commercial Fisheries (BCF), the forerunner of the present National Marine Fisheries Service (NMFS), NOAA, conducted unprecedented year-round oceanographic surveys, still unequalled in scope and intensity, over wide expanses of the Pacific Ocean from below the Equator to the Bering Sea. Those surveys were largely in support of tuna research conducted by the La Jolla and Honolulu Biological Laboratories, and Pacific salmon research at the Seattle Biological Laboratory. Unavoidably, the results of many oceanographic studies were not forthcoming for months (and in some cases years) after termination of the cruises, whereas the data from fishing cruises were normally immediately available. As a result, interest and support for oceanographic studies waned.

However, modern technology—in the form of salinity-temperature-oxygen-depth systems, chemical autoanalysers, and other sampling equipment—has greatly simplified the acquisition of data. Recently simple, automated, analytical equipment has become available that permits not only rapid analysis of data but a renewed and increasing demand for additional data related to the ecology of living marine resources.

One oceanic area of particular concern to the Northwest Fisheries Center (NWFC) is the northern Gulf of Alaska and eastern Bering Sea where important stocks of crustaceans such as king and snow (Tanner) crab, shrimp, and groundfish such as Pacific halibut and walleye (Alaska) pollock are being heavily exploited or affected by foreign fishing activities. There is an extensive data base of routine serial oceanographic observations in this area, as shown by a dotplot (Fig. 1) constructed from a portion of an oceanographic data geofile available at the National Oceanographic Data Center (NODC).

COMPUTER INFORMATION SYSTEM AND GRAPHICS SUITE

The Division of Resource Ecology and Fisheries Management of the NWFC has recently acquired data processing equipment composed of several components synthesized into a graphics-oriented remote computer suite, which is currently interfaced with the University of Washington CDC6400/CYBER73 computers via INTERCOM [1] (Control Data Corporation, 1975) at 30-120 characters per second transmission rate over regular telephone lines. The components—the CRT (cathode ray tube) terminal, the digitizer tablet, the disc memory unit, and printers (Figs. 2 and 3)—are used as an interactive computer cartography system for digitizing maps and displaying spatially and temporally distributed statistics computer from extensive environmental data bases. The suite provides improved access and analysis of not only extensive historical environmental data collected by countries contributing to World Data Centers and available at NODC (National Oceanographic Data Center, 1974) by geographic area of interest but also near real-time data from various agencies conducting field operations. All available station data have been implemented on an information storage and retrieval system, developed by L. Gales and D. J. Brown, called RIRS [2,3].

RIRS provides random-access, fast response (usually 1-5 minutes) retrieval of Boolean combinations of the keys or variables associated with the data base. Retrieved data are listed, summarized, or mapped onto a "live" atlas which can be interactively manipulated at the terminal. Any rectangular area of the map can be expanded to screen size (19-inch diagonal) by defining a

Favorite

Brown

Ingraham

F. Favorite, D. J. Brown, and W. J. Ingraham, Jr. are with the Northwest Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, WA 98112.

[1] Reference to trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

[2] Gales, L., and D. J. Brown, 1974. Setup procedure for RIRS: A randomized information retrieval system. Unpubl. manuscr., 12 p. Univ. Washington Sea Grant, NORFISH N133B.

[3] Gales, L., and D. J. Brown. 1974. Users guide for RIRS: A randomized information retrieval system. Unpubl. manuscr., 6 p. Univ. Washington Sea Grant, NORFISH N133A.

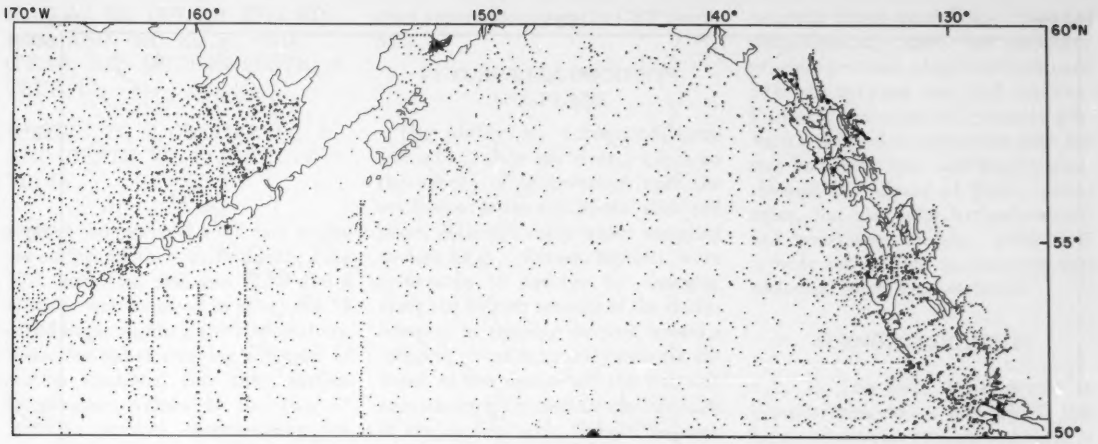


Figure 1.—Locations of all oceanographic stations within a portion of the NODC geofile acquired in June 1975.

rectangular block using adjustable x-y axis cross hairs. The tablet permits immediate on-screen digitizing of land contours, bathymetry, or any other form of x-y plots. Once created, a particular map can be stored remotely on the floppy disc and redisplayed, plotted for manuscript quality reproduction, or instantly printed on the hard copy unit.

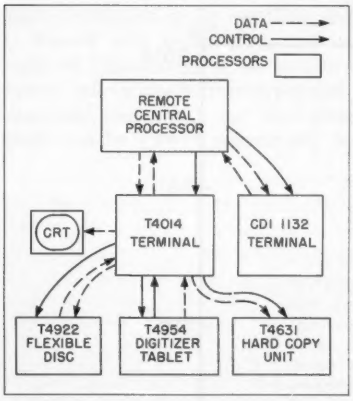


Figure 2.—Diagram of system components.

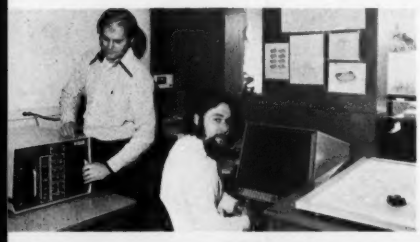


Figure 3.—W. James Ingraham, Jr. (left) and Daniel J. Brown (right), operating computer graphics components.

The results of a sample conversational retrieval and mapping session follow. The keys, variables, retrieval request, and computer costs are also given. The original NODC data have been reformated, eliminating extraneous and redundant information; the remaining keys and variables are:

Keys

CNY	Country
CRU	Cruise
CONS	Consecutive number
TEN	Ten degree square
ONE	One degree square
FIVE	Five degree square
LATD	Latitude degrees
LATM	Latitude minutes
LOND	Longitude degrees
LONM	Longitude minutes
YEAR	Year
MO	Month
DAY	Day
SHIP	Ship
DBOT	Depth to bottom, meters

Variables

DEPTH	Depth of sample, meters
TEMP	Temperature, °C
SALIN	Salinity, ‰
SIGT	Density, g/l
OXY	Oxygen, ml/l
DYD	Dynamic depth anomaly

Example 1—The following two statements,

IF ((TEN. EQ. 1417. OR TEN. EQ. 1418). AND. (MO. EQ. 6)) RETREVE =. TRUE.

IF ((FIVE. EQ. 3. OR FIVE. EQ. 4). AND. (DEPTH. EQ. 0)) RETREVE =. TRUE.

request the retrieval of all data at the sea surface from a 97,000 card image data base for the month of June in four 5° Marsden quadrants that encompass Bristol Bay and the western Gulf of Alaska. The retrieval cost was $4.59, and it took 8 minutes for the computer to respond after retrieving 488 card images from the master data file. Once the new data file is created, any of the variables or keys can be superimposed on a Mercator map projection of the area.

For example, LATD and LOND of station locations were selected and processed by a graphics program. This produced a dotplot superimposed on the appropriate portion of the map in 2 minutes (Fig. 4) that can be previewed on the terminal screen. The information is stored for re-use and a paper (hard) copy is made.

Example 2—The following two statements,

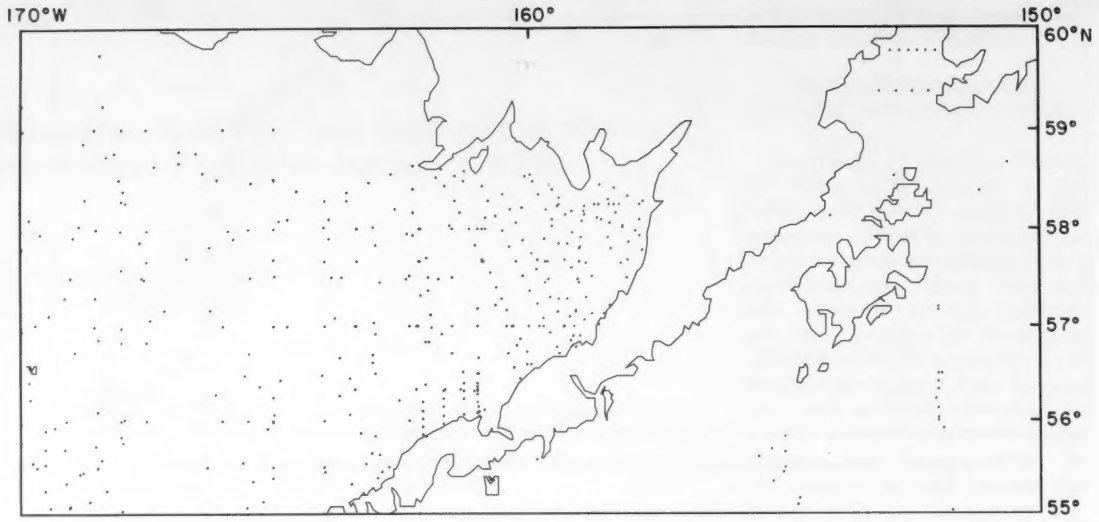


Figure 4.—Location of oceanographic stations available for the month of June.

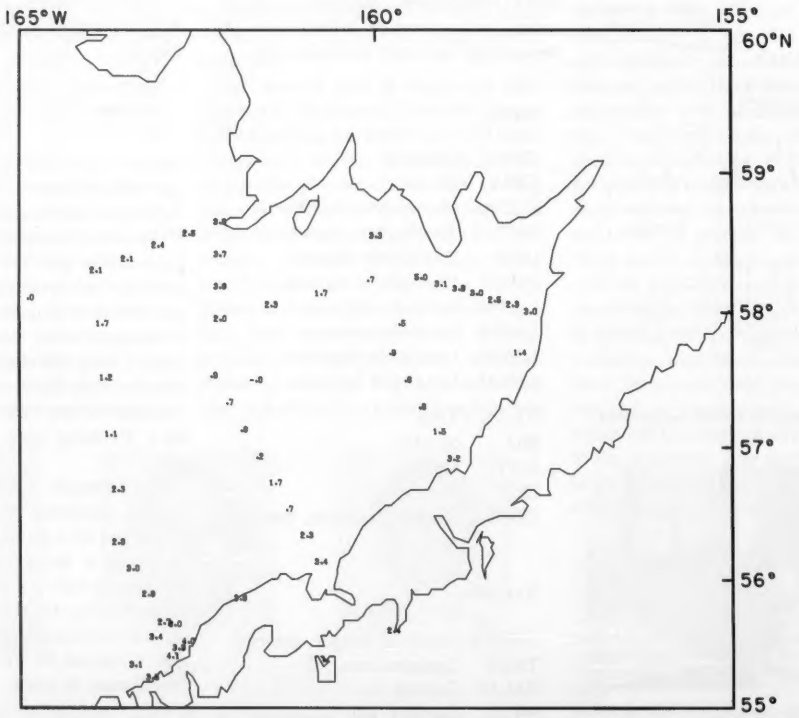


Figure 5.—Sea surface temperature (°C) data available for June 1971.

IF ((TEN. EQ. 1417. OR. TEN. EQ. 1418). AND. (MO. EQ. 6). AND. (YEAR. EQ. 1971)) RETREVE =. TRUE.

IF (FIVE. EQ. 3. OR. FIVE. EQ. 4). AND (DEPTH. EQ. 0)) RETREVE =. TRUE.

request the retrieval of all data at the sea surface for the specific month, June 1971. Retrieval cost was $1.60 and 4 minutes was required to select the 78 card images meeting the retrieval criteria. Instead of creating a dotplot of station locations, this time surface temperature values in the two 5° Marsden squares encompassing the eastern Bering Sea were selected, previewed, and printed (Fig. 5)—again, in a matter of seconds. These examples demonstrate two simple applications of data retrieval and the accompanying displays that assist in analyses of environmental conditions. Obviously the inherent versatility and capability of these new techniques provide convenient methods of studying various components of ecosystems. Maps with higher resolution of the coastline, and if desired with bathymetry, can be digitized interactively on the graphics tablet, and various horizontal physical, chemical, biological, and geological fields can be viewed sequentially or even superimposed on the CRT terminal.

FUTURE REQUIREMENTS AND PLANS

The ability to manipulate large amounts of data has clearly indicated the paucity of observations near the sea floor over the continental shelf and slope. Although early water sampling devices (e.g., Nansen bottles) were vulnerable to damage by dragging along the bottom because of the delays inherent in tripping devices, acoustic "pingers" (that accurately indicate the depth of the device off the bottom), acoustic tripping mechanisms (operable in conjunction with Nansen bottles), and salinity-temperature-depth sensors presently eliminate this problem. Nevertheless, although today an increasing number of marine scientists are interested in the total vertical field of mass, many will have to be encouraged to obtain observations of water properties down to the sea floor itself if we are to increase our understanding of the ecology of this area of the ocean.

This computer information system and graphics suite permits an interactive, iterative method of analysis of various environmental data, thus optimizing benefit of the speed of the conversational remote terminal and heuristic human capabilities. These are complementary roles, and computer graphics provides a high level language interface between man and machine. Further development of computer software is planned in conjunction with not only numerous "live" and historical environmental atlases of finite coastal areas, but also with hydrodynamical and ecosystem models, which will provide insight into multispecies and ecological interacting variables.

ACKNOWLEDGMENTS

L. L. Low was instrumental in initially bringing to the NWFC this form of computer graphic technique in relation to fisheries problems and has assisted us in establishing this program. Partial funds were provided by the NOAA Outer Continental Shelf Environmental Assessment Program (OCSEAP) through Research Unit No. 357.

LITERATURE CITED

Control Data Corporation. 1975. INTERCOM reference manual. Control data Cyber 70 computer systems, Models 72, 73, 74; 6000 computer systems. Control Data Corp., Calif.

National Oceanographic Data Center. 1974. User's guide to NODC's data services. Natl. Oceanogr. Data Cent., Environ. Data Serv., Key Oceanogr. Rec. Doc. No. 1, 72 p.

MFR Paper 1197. From Marine Fisheries Review, *Vol. 38, No. 8, August 1976. Copies of this paper, in limited numbers, are available from D825, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235. Copies of* Marine Fisheries Review *are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 for $1.10 each.*

United States Extends Exclusive Fisheries Jurisdiction to 200 Miles

On 13 April the President signed H.R. 200, the Fishery Conservation and Management Act of 1976, extending the exclusive fisheries jurisdiction of the United States to 200 miles. The Act has far-reaching implications for all nations which fish in waters off U.S. coasts, and the following is a summary prepared by the Department of State to describe the most important provisions of the Act.

The Act establishes a zone contiguous to the territorial sea out to 200 miles in which the United States assumes exclusive fisheries management authority, effective 1 March 1977, and asserts such authority over anadromous species (for example, salmon) of U.S. origin and continental shelf fisheries resources seaward of the zone. This authority does not extend to highly migratory species, such as tuna.

Foreign fishing may be permitted after 1 March 1977 to the extent of any surplus over the harvesting capacity of U.S. fishermen and under the optimum yield from each fishery. That is, the Secretary of Commerce and Regional Councils (see related story, next page) established by the Act will set the total allowable catch (TAC) for each fishery and determine what portion of this total will be harvested by American fishermen. The remaining surplus will be allocated among foreign fishermen by the Secretary of Commerce. In allocating the surplus to foreign fishermen, the Secretary of State shall take into consideration traditional fishing activity, whether such nations have cooperated in making substantial contributions to fisheries research, cooperated in enforcement with respect to the conservation and management of fishery resources, and such other matters as are deemed appropriate. However, foreign fishing in the zone, or for anadromous or continental shelf species in or beyond the zone, is prohibited after 1 March 1977 unless certain conditions are met, described below.

In the case of existing bilateral agreements that remain in force on 1 March 1977 (with Canada, South Korea, and the Atlantic Coast agreement with the Soviet Union), the parties to the agreements must obtain "registration permits" for each vessel from the Secretary of State in order to verify that their vessels are authorized to fish. In the case of continuing multilateral treaties, "registration permits" will be similarly required. This will involve some 18 nations, including Japan, Canada, the Soviet Union, Poland, Federal Republic of Germany, Spain, and others. Permissive authority is also granted to the Secretary of State to levy reasonable fees to recover administrative costs.

In the case of agreements that expire before 1 March 1977 (for example, Pacific Coast agreements with Japan, the Soviet Union, and Poland), no extension is permitted and the nations involved must conclude new "governing international fisheries agreements" that recognize our jurisdiction as set forth in the Act, and obtain permits for each vessel by which the Secretary of Commerce unilaterally sets the terms and conditions under which fishing is authorized. The "governing international fisheries agreements" must be in force on 1 March 1977. However, the Act requires that they lie before Congress for 60 days while Congress is in session before they enter into force.

With respect to the permits issued by the Secretary of Commerce, opportunity is provided for comments by interested parties with respect to these permits. The procedure is extensive and detailed. Essentially, the Secretary of State is required to receive applications from foreign countries and publish them in the Federal Register. Regional Councils established under the Act are allowed 45 days in which to comment on the applications and the Secretary of Commerce, after appropriate review and after consultation with the Secretary of State and the Secretary of Transportation, shall approve the application and establish the specific conditions and restrictions which shall be applicable to each permit. In addition, the Act provides for the payment of fees by foreign vessels issued permits to cover the cost of research, management, and administration of the law.

Any foreign fishing vessel that does not have on board a valid permit issued under an existing agreement or a new governing agreement will be seized and prosecuted. In addition foreign operators and vessels are subject to arrest, seizures, fines, and imprisonment for such unlawful acts as refusal to permit U.S. enforcement officers to board and inspect their vessels, fishing without a valid permit or in violation of the conditions stipulated in the permit, and resisting arrest. Criminal offenses are punishable by a fine of not more than $50,000 or imprisonment or both, or in the case where a person forcibly resists arrest and either injures or places the arresting officer in danger of physical harm, not more than $100,000 or one year in prison, or both. In addition, civil penalties may be imposed. They include forfeiture of catch, gear, cargo, and vessel.

Provision is also made with respect to the U.S. distant water fisheries, such as tuna and shrimp. If the Secretary of State is unable to conclude an international fisheries agreement within a reasonable period of time which would allow U.S. fishing vessels access to fisheries over which other nations assert exclusive fisheries management authority recognized by the United States, the Act provides for the imposition of import embargoes on fish products for the nation involved. Such an embargo can be imposed for: 1) refusing to commence negotiations, 2) failing to negotiate in good faith, 3) denying U.S. fishermen the opportunity to fish for highly migratory species in accordance with international agreements, or 4) seizing U.S. vessels under certain conditions. Compensation to U.S. fishermen under the Fishermen's Protective Act is expanded.

The Act also authorizes the Secretary of State to seek agreement with neighboring countries on the boundaries of the conservation zone of the United States.

Finally, the Act states that if the United States ratifies a comprehensive Law of the Sea treaty, the Secretary of Commerce, after consultation with the Secretary of State, may promulgate any such changes as are necessary to conform the administrative regulations to the requirements of the treaty.

NOAA and the Marine Fisheries Conservation Act

President Ford's signature on the new Marine Fisheries Conservation Act has given NOAA and the National Marine Fisheries Service significant new responsibilities for conservation and management of marine fisheries. The new law puts under U.S. control about 10 percent of the world's fishery resources—the largest fishery resource of any nation in the world, encompassing 2.2 million additional square miles of ocean.

Anticipating the enactment of such a law, NOAA Administrator Robert M. White established an Extended Jurisdiction Planning Office more than a year ago to plan NOAA's role when the bill became law and to provide technical assistance to the Congress in drawing up the legislation. William Royce headed the office until his retirement late last year, when he was replaced by Brian Rothschild. Present staff members are Dale Sortland and Stetson Tinkham. NOAA staff members from other components who are working closely with the office are Gary Smith and Bruce Norman from NMFS, Edward Klima from Marine Resources, Herbert Blatt from the Office of General Counsel, and Richard Grigg from Sea Grant.

REGIONAL COUNCILS

At the heart of the new management regime is a system of Regional Councils, which was to be established within 120 days after the President had signed the bill into law. Composed primarily of state and constituency representatives, the eight councils are: New England Council; Mid-Atlantic Council; South Atlantic Council; Caribbean Council; Gulf Council; Pacific Council; North Pacific Council; and Western Pacific Council. The number of voting members of each council varies from 7 to 19, depending upon the number of states and territories in each region.

Voting members of each council consist of the principal state official with marine fishery management responsibility in each state, designated by the governor; the regional director of the National Marine Fisheries Service; and additional members designated by the Secretary of Commerce from lists submitted by the state governors.

FISHERIES MANAGEMENT PLAN

The major task of each council is to prepare a fisheries management plan for each fish stock found within the waters of the region. Thus the states have the primary responsibility for taking part in the development of these management plans and seeing that they are implemented.

In addition to its resource assessment and research responsibilities, the Department of Commerce will now have the authority to review and approve management plans developed by the councils to ensure that they conform to national standards and other intents of the legislation.

The Secretary of Commerce also has the authority to promulgate other regulations required to implement the management plans, and to develop additional regulations in certain circumstances. NOAA's Extended Jurisdiction Planning Office has worked with the U.S. Coast Guard as it carries out its Congressionally mandated study to determine the kind of enforcement and surveillance systems that will be needed.

INTERNATIONAL AGREEMENTS

NOAA has also begun to work with the State Department on some of the difficult questions concerning the continuation of the bilateral and multilateral arrangements with other nations, once decisions are made on the basis for providing foreign nations with access to our fishery resources. Foreign fishing will be permitted under circumstances consistent with the provisions of the Act. Foreign vessels fishing in the zone—or for anadromous species or continental shelf fishery resources beyond the zone—will, after 28 February 1977, have to have a valid permit for such fishing.

Additional effort and resources will be required within NOAA to put the fisheries management regime into effect. Funding for ships, enforcement, research, staff work, and council operations will need to be increased. It is presently estimated that when the new regime becomes fully operative it will cost an additional $35 million annually, exclusive of enforcement costs that may be required by the Coast Guard.

Supplementing the NOAA in-house planning for extended jurisdiction have been planning and information efforts developed by the Sea Grant network. The bulk of these have been economic studies, with Bruce Rettig at Oregon State University and Virgil Norton at the University of Rhode Island analyzing the expected economic impacts of extended jurisdiction on, respectively, the west and east coasts. Another report by J. W. Devanney III, of the Massachusetts Institute of Technology Sea Grant program, dealt with factors affecting the income of fishermen and fish consumers as a result of the 200-mile fisheries limit.

NMFS Names Endangered Species Coordinator

Robert E. Stevens has been named endangered Species Coordinator for the National Marine Fisheries Service, a component of the National Oceanic and Atmospheric Administration (NOAA). Stevens formerly was with the Texas Parks and Wildlife Department in Austin, where he was the principal administrator for management of living marine fisheries resources on the Texas coast.

In his new position with the Commerce Department agency, Stevens will be responsible for developing and implementing conservation policy, procedures, and regulations necessary in administering the endangered species program.

Stevens has had extensive fishery experience at both the state and federal levels, as well as with industry. He received an A.B. degree in business administration from the College of William and Mary, and his B.S. degree in zoology from North Carolina State University. He was awarded his Ph.D. in zoology from North Carolina State in 1970.

Hovis Directs NOAA Satellite Laboratory

Warren A. Hovis, Jr., of Severna Park, Md., an expert in remote sensing of natural phenomena from satellites, has been appointed Director of the Satellite Experiment Laboratory of the

National Environmental Satellite Service, an element of the National Oceanic and Atmospheric Administration (NOAA). In his new post, Hovis will be involved with expanding the capabilities of NOAA's environmental monitoring satellites in providing information about the earth, its atmosphere, and its oceans. He previously was Associate Chief for the Earth Observation Systems Division at Goddard Space Flight Center, National Aeronautics and Space Administration.

A member of the American Institute of Physics and the Optical Society of America, Hovis has published technical papers on atomic and molecular spectroscopy, infrared spectral measurements, and other subjects within his area of research experience.

He received both his A.B. and Ph.D. degrees in physics from Johns Hopkins University.

Munson Sworn in, Heads Atlantic Marine Center

Robert C. Munson, a 24-year veteran of the National Oceanic and Atmospheric Administration's NOAA Corps, was sworn in 30 April 1976 as Director of the Commerce Department agency's Atlantic Marine Center in Norfolk, Va., by NOAA Administrator Robert M. White. He succeeded the retiring Alfred C. Holmes.

The ceremonies, held on the fantail of the NOAA Ship *Pierce*, were witnessed by 200 NOAA Corps officers and personnel of the Center. Allen L. Powell, Director of NOAA's National Ocean Survey, introduced White who administered the oath. As Director of the Atlantic Marine Center, Munson will have jurisdiction over the eastern seaboard and the Great Lakes, including ship bases at Norfolk and Miami.

The Atlantic Marine Center is home port for seven NOAA vessels which conduct ocean surveys, hydrographic, circulation, and wire drag operations in the Great Lakes, the Atlantic Ocean and the Gulf of Mexico. These ships are the *Mt. Mitchell*, *Pierce*, *Whiting*, *George B. Kelez*, *Ferrel*, *Rude*, and *Heck*.

Two NOAA ships based in Miami, the *Researcher* and the *George M. Bowers*, are engaged in deep ocean investigations and marine surveys. Additionally, the *Albatross IV*, out of Woods Hole, Mass.; the *Delaware II* from Sandy Hook, N.J.; and the *Oregon II*, Pascagoula, Miss., are being used in NOAA's Living Resources Survey program.

Munson, a native of Oneonta, N.Y., has served as Associate Director of the National Ocean Survey's Office of Marine Surveys and Maps since May 1972. He was graduated from Cornell University with a civil engineering degree in 1951, and in 1967 received a master's degree in geophysical engineering from the Colorado School of Mines.

NOAA Funds Satellite Eye on Ocean Productivity

A $170,000 contract for the design of systems and techniques to permit the monitoring of ocean productivity by global orbiting satellites has been awarded the Scripps Institution of Oceanography, University of California, San Diego, by the National Oceanic and Atmospheric Administration (NOAA). David S. Johnson, Director of NOAA's National Environmental Satellite Service, said measurement of ocean productivity by satellite would be a major contribution and service, both to the commercial fishing industry and to ecologists.

"The value to the fishing industry in maintaining and managing the oceans' living resources is obvious," Johnson said. "And, the importance of being able to continually monitor properties which would indicate any ecological changes in the oceans is increasingly significant as we become more responsibly concerned with man's impact upon his environment."

The Scripps contract from the Commerce Department agency will fund research on the relationship between the amount of chlorophyll *a* contained by phytoplankton—microscopic plant life in the oceans—and the color of the sea as observed from a satellite, according to Jack Sherman, Chief of NESS's Spacecraft Oceanography Group. Tropical oceans are clear and blue, Sherman explained, because they are almost devoid of any significant plankton growth. The north Atlantic, particularly in the fishing grounds off the Grand Banks and Iceland, is green because it is rich in plankton.

Phytoplankton is at the beginning end of the food chain which supports higher life forms in the ocean, Sherman said. The primary productivity of a water body is directly related to the presence of amounts of phytoplankton containing chlorophyll *a*.

The Scripps research is a necessary step in preparing to use observations from the Coastal Zone Color Scanner instrument to be carried into space aboard NASA's NIMBUS-G spacecraft to be launched in 1978. This will be the first satellite instrument dedicated to providing data on ocean bioproductivity, according to Sherman.

A large part of the research task will be focused on processing and analyzing data acquired off Southern California last fall by scientists from NOAA, Scripps Institution, NASA's Goddard Space Flight Center and Ames Research Center, and the Environmental Research Institute of Michigan. This work resulted in a wealth of in-situ physical and optical data, as well as simulated satellite data acquired by coordinated aircraft overflights and research ship cruises. The 1975 activity was designed and directed by Roswell Austin of Scripps and Dennis Clark of NOAA's satellite agency. Both are members of the NIMBUS-G Coastal Zone Color Scanner team.

Marine Mammal Law Violator Convicted

Jerry D. Mitchell, formerly of Key Largo, Fla., was convicted 4 May 1976 in Federal District Court, Key West, Fla., for criminal violations of the Marine Mammal Protection Act. This was the first criminal conviction under the Act according to William H. Stevenson, Southeast Regional Director of the National Marine Fisheries Service (NMFS), an agency of the Commerce Department's National Oceanic and Atmospheric Administration.

Mitchell, who now resides in Chula Vista, Calif., was found guilty in a jury trial on 24 counts of a 32-count indictment charging him with the capture and sale of 21 Atlantic Bottlenose Dolphins (porpoises) in the vicinity of the Bahama Islands during the spring and summer of 1974, and conspiracy to violate the Federal law. The defendant

was found innocent of the remaining 8 counts.

The case was investigated by NMFS Special Agents operating from their Regional Division office in St. Petersburg, Fla. Senior Resident Agent Winthrop A. Haskell supervised and coordinated the investigation with the assistance of Bahamian officials and the U.S. Customs Service. Haskell also served as case agent during the trial, assisting Assistant U.S. Attorney Donald Ferguson and National Oceanic and Atmospheric Administration attorney John B. Dunnigan in presenting the government's case.

Third International Nautical Chart Printed

Publication of the third of five international nautical charts has been announced by the National Oceanic and Atmospheric Administration (NOAA). Prepared by NOAA's National Ocean Survey, the chart, INT 513, covers the southern portion of the Bering Sea, including the Aleutian Islands, and is issued as part of a multination program sponsored by the Monaco-based International Hydrographic Ogranization (IHO).

The IHO program will provide a standard series of charts for the entire world which can be used by all nations. Each IHO member nation is authorized to reprint charts in its own language, but must employ the same form of navigational information, such as depth curves, sounding spacing, aids to navigation, and nautical symbols. Nations that have agreed to produce and issue international charts are Canada, West Germany, United Kingdom, France, Brazil, Argentina, Chile, Italy, Netherlands, Japan, India, New Zealand, Australia, and South Africa.

Published by the Commerce Department agency's office of Marine Surveys and Maps, the new chart is 1:3,500,000 scale, and the third metric nautical chart issued by the National Ocean Survey. It was compiled in accordance with IHO specifications and shows elevations as well as depths in metric units. Loran-C lines of position for electronic navigation are shown in addition to the usual nautical chart information.

The final two charts in the series being prepared by NOAA's National Ocean Survey will cover the Gulf of Alaska from the Canadian border to the Aleutian chain, and the northeastern Pacific from Alaska to Hawaii, including the U.S. west coast. The first chart, INT 501, published by the Survey last fall, covered a vast area of the Pacific Ocean off the west coast of the United States and Canada, and the second chart, INT 514, showed the northern portion of the Bering Sea. The new chart, International chart INT 513 (National Ocean Survey Chart 513) is priced at $3.25, and may be obtained from the NOS Distribution Division (C44), Riverdale, MD 20840.

Northeast Pacific Ocean area covered by new NOAA chart.

Tide Monitoring Station Open on Chesapeake Bay

An automatic tide recording station, installed on the Chesapeake Bay Bridge Tunnel to serve as a research and development facility for improving technology involved in the measurement of tides and water levels, became operational on 10 April, the National Oceanic and Atmospheric Administration (NOAA) has announced. The station, on one of the most important Atlantic Coast waterways, is the result of 3 years effort by NOAA's National Ocean Survey and the National Weather Service, the U.S. Army Corps of Engineers, and the Chesapeake Bay Bridge Tunnel Commission. It is maintained by the Survey's Atlantic Marine Center in Norfolk, Va.

Allen L. Powell, Director of the Commerce Department agency's National Ocean Survey, said the Bay Bridge Tunnel station can operate up to 10 different types of tide gaging or scientific equipment simultaneously, providing the Survey with an "invaluable aid in the evaluation, testing, and improvement of techniques of various equipment essential to obtaining more and better knowledge of our oceanic environment." Such tide measurements, Powell said, "serve the needs of the mariner, the engineer, the scientist, and the general public."

The station's tide recorder will automatically telemeter water levels to the National Weather Service at the Norfolk (Va.) Airport, providing information to aid in warning the public of rising water levels from winds or heavy rains not only in the immediate area but also the Upper Bay areas where flood waters are a chronic threat to residents of low lying sections. Information transmitted to the U.S. Army Corps of Engineers in Norfolk will assist in the design of construction projects as well as allow additional time to establish precautionary measures during flood periods.

In addition to satisfying nautical charting requirements of the National Ocean Survey, tide measurements also: 1) Determine mean sea level and other tidal datums for surveying and engineering purposes and to establish a system of tidal bench marks to which these datums can be referred; 2) Provide data for tide predictions and

publication of this data in annual tide prediction tables; 3) Investigate fluctuations of sea level and crustal movements of the earth; 4) Supply information concerning tidal conditions for engineering projects; 5) Provide pertinent data for special estuarine studies; and 6) Determine marine boundaries, both state and federal, for coastal zone planning and in some cases, litigation, as well as various other maritime interests.

The Bay Bridge Tunnel station, constructed on the fishing pier, replaces the Virginia Beach station which was destroyed by storms or strong winds five times in 10 years. It joins a long and historical list of tide observation sites for the Chesapeake Bay area, dating back to the earliest at Annapolis, Md., 6 June 1844, and Old Point Comfort, Va., 1 July 1844.

Central Puget Sound Circulation Studied

A search for clues to the uncommon ability of Puget Sound and other deep, cold-water estuaries to digest pollutants—and the limits of that capacity—is being conducted by National Oceanic and Atmospheric Administration (NOAA) scientists in Seattle, Wash.

Using a moored string of seven current-meters suspended beneath a subsurface buoy, NOAA scientists are developing the first detailed three-dimensional view of water circulation in the Sound. From the information collected, researchers expect to learn why the Sound, although bounded by large population centers, remains relatively pristine. They also expect to be able to develop and refine models used in predicitng circulation in Puget Sound, which, with modifications could be applied to other deep, cold-water estuaries.

The year-long current-measuring effort is being conducted by the Commerce Department agency's Pacific Marine Environmental Laboratory (one of NOAA's Environmental Research Laboratories) as part of a new Marine Ecosystems Analysis (MESA) Puget Sound project. The MESA program seeks to determine the impact of human activities on marine life and environment.

The present current-meter mooring was deployed in the central basin of Puget Sound in 650 feet (200 meters) of water north of West Point in September 1975. It will obtain data at two-to-three-month intervals until this September. During one month this summer, five moorings will be deployed in the central Sound to study spatial variations in circulation, and present plans call for additional studies at other Sound locations through next year. Vessel support for this work comes mainly from NOAA's 175-foot (53-meter) ship *McArthur*, based at the Pacific Marine Center in Seattle.

We're mainly concerned with determining behavior of the Sound and the impact of wastes," explained Glenn Cannon, the NOAA oceanographer directing these field studies. "The current-meter mooring is near the largest of four sewer outfalls entering the Sound from the greater Seattle area. This is an area where we've made measurements previously, so that we have some continuity."

The Sound is deep, and its circulation is complicated by rapid tidal currents, relatively high tides, and changing winds, Cannon said. "Based on our earlier studies of circulation near West Point, it looks as though the deep water in the Sound can mix itself in about a month, at least in winter. This rapid mixing means the Sound can handle a large amount of waste, but there's bound to be a limit. We want to determine these mixing mechanisms, and their limitations."

Seasonal changes play a dominant role in the way Puget Sound water moves through the deep estuary and its complex of inter-island channels, he said. As the study progresses, the NOAA investigators will obtain the longest and the first full-year set of circulation measurements at a location in the Sound.

Cannon noted that Puget Sound is unique in the United States south of Alaska. "It's like a fjord in being deep," he said, "but a classic fjord is fed by some fresh water source near its head. The Sound gets a significant part of its fresh water near the seaward end of the estuary north of Seattle."

Understanding how Puget Sound removes pollutants by mixing will do much to help environmental managers preserve this unique, comparatively unpolluted estuary. It will also provide a useful tool for local governments as they make the costly decisions on how to bring their waste-treatment systems up to present federal standards. The Puget Sound study also has special implications for Alaska, where oil exploration and development will bring increasing population—and increasing environmental pressures—on the northern state's deep bays and inlets.

Foreign Fishery Developments

Irish Triple Fish Catch Since 1964

The Irish fishing industry has grown dramatically in the last 10 years, according to the NMFS Office of International Fisheries. From 1963 to 1974, the industry's contribution to Ireland's Gross National Product has increased from US$2 million to US$57.5 million[1]. This total is expected to reach US$205 million by 1984.

Growth began in 1964, after a study by U.S. fishery experts concluded that Ireland offered profitable commercial fishing opportunities, because of its proximity to major fishing grounds and both United Kingdom and European markets. Since then the Irish government has encouraged expansion of shore-based facilities and processing plants by fostering investment and providing grants and loans. Development has been insured through the establishment of national catch quotas to conserve certain species. In the course of the last decade, Irish fisheries have developed into an integrated, export-oriented industry. Despite current marketing difficulties and rising costs of fishing operations, the Irish fishing industry is likely to continue expanding.

The total catch has nearly tripled in the past 10 years (see Fig. 1). Pelagic species, particularly herring, account

[1]A conversion rate of US$1.00 = 0.49 Irish pounds was used in this report. GNP data are from *The Irish Skipper*.

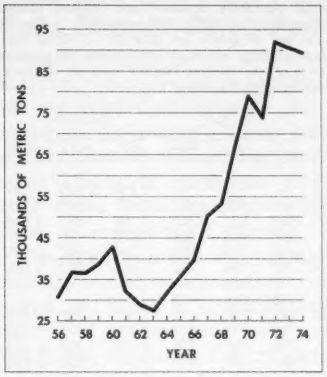


Figure 1.—Ireland's total fish catch, 1956-74.

for 60 percent of the catch by weight. The demersal catch, though less important, includes whiting, haddock, cod, plaice, skate, and other groundfish. Freshwater and Atlantic salmon fisheries are also important: exports of Atlantic salmon alone earn US$6 million per year, or almost 25 percent of the total gross value of the entire Irish fisheries catch. However, only 15 percent of all fish taken off Ireland is landed by Irish vessels, which are not large enough to fish far from the coast. The rest is taken by fleets from other European countries.

EXPORTS AND IMPORTS

More than half of the total catch is exported. The major export commodities are herring, salmon, and shellfish. The United Kingdom is the largest importer of Irish fishery products. In 1973, exports to that country totalled US$7.8 million. Other significant markets for Irish fishery products are France, the Netherlands, and the Federal Republic of Germany. Exports to each of these countries averaged US$3.1 million. Imports by the United States remain comparatively small, about US$422,000 in 1973. In 1974 the value of exports of all types of fish and fishery products reached US$25 million compared to US$22.5 million in 1973 (see Table 1).

The value of fishery imports, mainly fish meal and canned fish, has declined. In 1974, imports were estimated at US$9.8 million compared to US$10.2 million in 1973. Domestic consumption in recent years has risen in response to vigorous sales promotion. Per capita consumption of fish and fishery products in 1974 was 11.8 kilograms (26 pounds) and is expected to increase 10 percent by 1980.

Table 1.—Ireland's fishery exports, 1971-74.

Year	Quantity (metric tons)	Value (US$)
1971	37,859	11,945,956
1972	48,758	16,246,452
1973	51,465	22,547,950
1974	47,554	25,950,950

Source: *OECD Review of Fisheries*, 1974.

FLEET

The Irish fisheries are coastal and the fleet consists almost entirely of short-range craft. The fleet consists mainly of the Scottish-type trawlers, with capacities of 51-75 gross registered tons, although in recent years there has been a trend toward the acquisition of larger vessels. The remainder of the fleet consists of 1,200 smaller craft of up to 7 meters in length, powered mainly by outboard engines. Ireland had 6,138 fishers (3,890 part-time) in 1974, or about one percent of the total labor force.

GOVERNMENT SUBSIDIES

Industry growth is supported by the Board Iascaigh Mhara (BIM) or the Irish Sea Fisheries Board, a government development corporation. BIM is divided into four major sections: fisheries resources, domestic and export markets, investment, and shipbuilding. The bulk of aid for capital development is in the form of grants for the purchase of new fishing boats. Purchasers receive outright grants on 25 percent of the cost for fishing vessels measuring 20 to 86 feet long, in addition to a loan covering the remaining costs at 4 percent interest over 10 years. The capital development fund allocated for the fishing industry in 1975-76 was US$9.8 million or 40 percent greater than in 1974-75. Development plans for the industry include: 1) strengthening the existing coastal fleet and expanding into midwater fishing; 2) expanding and integrating shore-based facilities to insure maximum employment and more effective marketing; and 3) developing mariculture for fish and shellfish.

FISHERIES LIMITS AND NEGOTIATIONS

Currently, Ireland claims a 12-mile fishing zone, but Irish fishers are demanding its extension to 50 miles. Fishers are also demanding that Ireland renegotiate the EEC Fisheries Agreement, which allows EEC countries to fish up to 6 miles off the Irish coast, in light of the rapidly diminishing stocks and the extended jurisdiction developments.

Taiwan Exports Eels to Japan

A meeting in Taipei, Taiwan, of Japanese eel importers and Taiwanese eel producers resulted in agreement that 14,000 metric tons of eels would be exported from Taiwan for sale in Japan during 1976. Of the total amount, 11,000 metric tons will be live eels and 3,000 metric tons will be processed eels. The export price for live eels was set at $6,000-$7,000 per ton.

Taiwanese eel culturists have agreed to import Japanese eel (*Anguilla japonica*) elvers to raise to maturity. Final details of the trade agreement were worked out at another meeting in May. (Source: *China Post.*)

According to the NMFS Office of International Fisheries, Japan imported 7,689 metric tons of live eels from Taiwan in 1974 and 10,843 metric tons in 1975. Average prices per ton in those years were $5,980 and $5,950, respectively. Japanese eel culturists have been hit hard by increased prices for fuel used to maintain water temperatures during the winter months, but Taiwanese eel culturists, benefiting from their milder winters, appear able to expand production to meet the Japanese market demand.

Japan imported only 13 metric tons of live eels from the United States in 1974 and only 8 metric tons in 1975. Furthermore, average prices per ton for live American eel exports to Japan were $4,430 in 1974 and $2,890 in 1975. U.S. eel exports to Japan have been held back by transportation costs, by a general world economic slump during 1975, and by the Japanese market preference for *Anguilla japonica*, the domestic eel. (Source: *Japan Exports & Imports* and others.)

DENMARK LISTS 1973-1975 FISHERY DATA

Stable cod landings since 1973 and a decline in fish landed for reduction from 1974 to 1975 are reflected in fishery statistics released recently by the Danish Fisheries Ministry. The data include landings and prices of cod and reduction fish and monthly prices of salmon and shrimp.

While cod landings remained relatively constant from 1973 through 1975, cod prices declined from 3.02 Danish krone (US$0.49) per kilogram in December 1973 to 2.66 krone (US$0.43) in December 1975 (Table 1). Landings of fish for reduction to fish meal and fish oil decreased from 1.57 million metric tons in 1974 to 1.47 million metric tons in 1975. The price per kilogram dropped from 8.6 cents in 1973 to 5.9 cents in 1975 (Table 1).

Shrimp prices were well below those prevailing in 1973 and 1974, and fell to 4 cents per kilogram in December 1975, compared to 15 cents in December 1973 (Table 2).

Monthly shrimp landings in 1975 for both Denmark and Greenland (Table 3) totalled 11,500 metric tons—2,139 metric tons for Denmark and 9,361 metric tons for Greenland.

Table 2.—Average monthly prices for landings of shrimp (*Pandalus borealis*) and salmon (Baltic *Salmo salar*) for 1973, 1974, and 1975 in Danish Krone per kilogram (at US$1.00 = DKr6.156). Where landings are nil or inadequate, no average price is given. (Source: Danish Fisheries Ministry, "Oversigt over Fiskeriet.")

	Shrimp			Salmon		
Mo.	1973	1974	1975	1973	1974	1975
Jan.	—	—	—	3.218	2.430	2.121
Feb.	.823	.987	.632	3.177	2.495	1.995
Mar.	.699	.911	.559	3.166	2.601	2.018
Apr.	.630	.746	.568	3.376	2.425	2.171
May	.644	.777	.526	3.244	2.347	2.055
June	.700	.780	.465	2.909	2.323	2.030
July	.717	.822	.507	—	—	—
Aug.	.728	.664	.489	—	—	—
Sept.	.821	.748	.512	2.057	1.726	2.229
Oct.	.792	.757	.507	2.138	1.671	2.738
Nov.	.755	.752	.535	2.422	1.982	2.992
Dec.	.950	.851	.255	2.641	2.033	3.720

Table 1.—Landings (in metric tons) and prices (in Danish krone per kilogram at US$1.00 = DKr6.156) of cod and fish for reduction in Danish ports by Danish and foreign vessels for 1973, 1974, and 1975. Source: Danish Fisheries Ministry, "Oversigt over Fiskeriet."

	Cod						Fish for reduction					
	Landings (whole wt.)			Price (DKr/kg)			Landings			Price (DKr/kg)		
Month	1973	1974	1975	1973	1974	1975	1973	1974	1975	1973	1974	1975
Jan.	15,884	17,805	12,949	1.95	2.94	2.61	62,698	63,279	69,168	0.41	0.63	0.42
Feb.	15,576	19,479	23,097	2.01	2.83	1.92	70,966	91,881	136,255	0.41	0.64	0.35
March	22,030	17,444	14,709	1.84	2.81	2.13	106,251	92,926	89,513	0.41	0.63	0.29
April	10,525	13,920	14,552	2.01	2.65	2.03	56,606	109,577	49,236	0.40	0.58	0.22
May	16,876	11,582	16,646	1.99	2.76	2.07	186,429	203,556	195,479	0.40	0.53	0.24
June	10,253[1]	7,727	10,938	2.22	2.79	2.02	142,951	206,349	177,749	0.42	0.49	0.25
July	9,709	6,957	8,691	2.20	2.66	2.09	135,075	98,089	191,420	0.40	0.45	0.25
Aug.	9,569	11,215	8,141	2.69	2.12	2.24	150,014	232,172	193,686	0.48	0.43	0.28
Sept.	6,855	5,591	6,941	3.09	2.97	2.67	113,484	117,798	118,718	0.52	0.45	0.31
Oct.	8,067	9,472	9,753	3.06	2.85	2.78	79,847	168,296	126,790	0.52	0.45	0.33
Nov.	7,053	8,994	5,403	3.14	2.69	2.76	69,807	123,431	69,872	0.43	0.52	0.32
Dec.	6,790	5,990	6,076	3.02	2.86	2.66	25,005	63,603	53,467	0.54	0.43	0.35
Total	139,187	136,176	137,896				1,199,133	1,570,957	1,471,353			

Table 3.—Monthly shrimp landings for Denmark and Greenland in 1975.

	Landings		
Mo.	Denmark	Greenland	Total
Jan.	1	270	271
Feb.	120	418	538
Mar.	192	173	365
April	480	735	1,215
May	336	852	1,188
June	288	1,375	1,663
July	288	1,283	1,571
Aug.	209	934	1,143
Sept.	162	1,059	1,221
Oct.	24	1,178	1,202
Nov.	39	705	744
Dec.	—	379	379
Total	2,139	9,361	11,500

[1] Landings listed in metric tons.
[2] Source not given.

ROK Longliner Seized off Alaska and Fined

A U.S. Coast Guard aerial patrol sighted a Republic of Korea (ROK) longliner, the *Dong Won No. 709*, fishing 11.25 miles offshore in the vicinity of White Sisters Island off the southeastern coast of Alaska on 18 February 1976, reports the NMFS Office of International Fisheries. The Korean vessel was advised that it was in violation of the U.S. Contiguous Fishing Zone (CFZ) and signalled to stop. While aerial surveillance was maintained, the Coast Guard Cutter *Sedge* was dispatched to intercept and board the vessel. The *Dong Won No. 709* was boarded and seized on 19 February.

The ROK vessel was taken to Sitka, Alaska, where the U.S. Marshall took custody of the vessel. The Coast Guard boarding officer and a National Marine Fisheries Service agent traveled to Juneau for debriefing and case preparations. On 24 February, the master of the *Dong Won No. 709*, Young Il Choi, was arraigned in the U.S. District Court in Anchorage. Asserting that he had been 12.5 miles offshore when the Coast Guard aircraft flew over his ships, and that his gear was 13.0 miles offshore, he pleaded not guilty to the charges. On 10 March, he changed his plea to no contest. The *Dong Won No. 709* was then found to be in violation of the CFZ.

Under the provisions of the Bartlett Act (16 USC 1081), the master of the vessel was fined $8,000 and the owner of the vessel was assessed $522,000 in civil penalties. Although payment of the $530,000 total was expected on 17 March, the vessel remained in custody until 25 March, at which time the penalties were paid and the vessel was allowed to depart the Sitka Harbor.

According to the NMFS Office of International Fisheries, the *Dong Won No. 709* is a 55 meter, 629.25 gross-ton longliner. Its homeport is Pusan, ROK, and it is owned by the Dong Won Ice Company. The vessel carries a crew of 35. Its value was estimated at about $1 million. The value of its catch was estimated at $220,000. At the time of boarding, the vessel's catch consisted of approximately 250 metric tons of frozen blackcod, and 3 metric tons of frozen rockfish. The *Dong Won No. 709* is the third Korean vessel seized for violating U.S. fishing laws since 1973. The stern trawler *Kum Kang San* was assessed $415,000 in penalties for a CFZ violation in August 1975.

Panama Plans New Port Sees Shrimp Catch Fall

The master plan for the fishing port at Punta Vacamonte, the key project in the Government of Panama's plan to modernize the country's fishing industry, was recently delivered to government officials in ceremonies at the project site, according to the NMFS Office of International Fisheries.

The plan was drawn up by a multinational consulting consortium composed of PISTSA (Panamanian), Greiner (American), and Livesey and Henderson (English). The complex is being financed by a $25 million loan from the World Bank. The National Port Authority has received the qualifications of 37 firms indicating an interest in bidding on the construction of the port, and has approved 21 firms for the submission of bids. American firms approved include Morrison-Knudsen Co., Inc., Raymond Corp., and Western Contracting Corp.

The old fisheries port was located in the center of Panama City. Expansion would have been difficult because of the high cost of urban real estate. In addition, tides limited the times when fishing vessels could enter and leave the port, and pollution, due to the port's urban location, made processing difficult.

The new fishing port will be protected by a breakwater and dredged to a depth sufficient to allow 24-hour-a-day operations. The facility will include an administration building, fresh fish market, areas for the construction and repair of boats, three service piers, two piers for the unloading of shrimp and fish, and two piers for tuna. Buildings for use by shrimp packing companies and a 3,000-ton capacity cold storage facility will also be built. Construction on the access road linking Punta Vacamonte with the Inter-American Highway is now 50 percent completed, and the road should be finished by July 1976, thus facilitating access to the construction site. The government expects to have the facility ready for operation by the fall of 1978. Areas have been designated in the master plan for future expansion of the Port.

Figure 1.—Panama's shrimp catch, 1960-75.

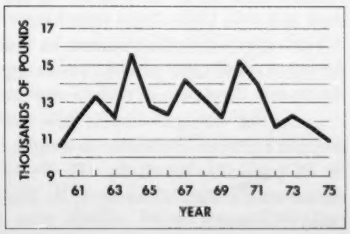


Table 1.—Panama's shrimp landings by species 1974 and 1975, in thousands of pounds.

Species		Landings		Percent change
Spanish	English	1974	1975	
Blanco	White	3,841	3,720	−3.2
Rojo	Pink	3,021	3,333	+10.3
Titi	Sea bob	3,668	2,158	−41.2
Carabalí	—	364	276	−24.2
Solenocera	—	104	75	−27.9
Fidel	—	147	951	+546.9
Cabezón	—	507	397	−21.2
Total[1]		11,652	10,909	−6.4

[1]Totals may not agree due to rounding.
Source: Ministerio de Comercio e Industrias. Departamento de Recursos Marinos.

SHRIMP FISHERY

Preliminary figures for 1975 from the Panamanian Ministry of Commerce and Industry indicated that shrimp landings for 1975 totalled 10.9 million pounds, down 6.4 percent from the 1974 catch and 16 percent below the 1965-74 average catch. This continues the decline from the record 15.2 million pounds landed in 1970 (Fig. 1). According to preliminary data the most significant decline took place in the sea bob (titi) catch which declined over 40 percent (Table 1). On 8 January 1976, a seasonal closure was declared on shrimp fishing during February and March for the white, sea bob, and carabali varieties.

The Minister of Industry and Commerce has drafted a new law designed to limit the number of fishing licenses issued for shrimping. In the past there has been a great deal of speculation on fishing licenses and the fishers have been able to sell their licenses to other individuals for up to $15,000. However, they are presently worth a great deal less because of the problems in the shrimp industry. Under the new law, shrimp licenses will automatically be revoked when the licensed vessel sinks or ceases operation, unless the vessel is replaced within 6 months. In addition, if the new law is enacted, fishers will not be allowed to sell their licenses.

Mexico Purchases 20 Cuban Fishing Vessels

Mexico has purchased 20 Cuban fishing vessels in what President Echeverría described as an example of Latin American economic and technological collaboration. During a christening ceremony for the first 13 vessels, held in Cozumel on the east coast of the Yucatan Peninsula, Echeverría emphasized the close relations existing between Mexico and Cuba. Agreement for the construction of the vessels was presumably reached as a result of President Echeverría's trip to cuba in August 1975. Cuba's First Deputy Director for Fisheries, Alvaro Lavastida, had previously presented a ferro-cement vessel to the Mexicans at the end of his trip to that country in January 1975. The Mexican government plans to use the vessels for training at Mexico's 30 secondary level technical schools. (Source: U.S. Embassy, Mexico City.)

According to the NMFS Office of International Fisheries, the vessels, built by "CubaPesca" in Cardenas and Manzanillo shipyards, are constructed from ferro-cement, a relatively new technique using plasticized wire mesh filled with a sand silicate mortar. Ferro-cement vessels have the advantage of low construction costs and are relatively inexpensive to repair and maintain. Each of the new vessels is 16.2 meters long and displaces 40 tons. They are designed for coastal operations on the continental shelf in tropical and severe weather conditions. Some of the vessels have a refrigeration capacity of 20 cubic meters, others have an 8-cubic meter refrigeration capacity and a 7-cubic meter holding tank[1]. Each vessel is powered by a 150-hp diesel engine and is capable of speeds up to 8 knots. They have a crew of 8 and are capable of trips lasting 5½ days. The vessels are well suited for shrimp and snapper fisheries.

Cuba has approximately 300 ferro-cement vessels in operation at the present time.

[1]These vessels were prominently displayed at the Cuban pavillion at the Inrybprom-Exhibition in Leningrad during August 1975. The vessels displayed at Leningrad were designed to keep the catch alive by circulating seawater in the perforated hold.

USSR Reports 1974-75 U.S. West Coast Fish Catch

The Soviet Ministry of Fisheries has transmitted to the National Marine Fisheries Service the final 1974 statistics and preliminary 1975 statistics for the catch made by Soviet vessels fishing off the Pacific coasts of Canada and the United States, according to NMFS's Office of International Fisheries. The latest data, in comparison with former years, were submitted in the detailed format stipulated by the U.S.-USSR Agreement on North Pacific Fisheries.

The 1974 final catch statistics (Table 1) show the Soviet Alaska pollock fishery in the eastern Bering Sea and the Gulf of Alaska as the most significant, amounting to almost 362,000 metric tons, or 52 percent of the total. The Pacific hake fishery off northern California, Washington, and Oregon was also large, amounting to about 159,000 metric tons, or 22 percent of the total Soviet catch off the U.S. Pacific coast.

The 1975 preliminary catch statistics (Table 2) show that the Soviet catches, for the most part, remained within the quotas set by the U.S.-USSR Agreement on North Pacific Fisheries for 1975 and 1976. (The quotas, and 1975 catch totals as a percentage of the quotas, are shown in Table 3.) Overruns were recorded only for the rockfish fishery in the Gulf of Alaska and for composite fisheries for other species in the Gulf of Alaska and off the Aleutian Islands.

Table 1.—Russia's 1974 fisheries catch (final statistics by fishing grounds) off the Pacific coasts of the United States and Canada in metric tons.

Species	Eastern Bering Sea	Aleutian Islands	Western Alaska	Eastern Alaska	Wash., Oreg., Calif.	Total (U.S.)	Percent of U.S. Total	Total Canada	Grand total
Pac. halibut	123	4	48	12	—	187	negl.	—	187
Arrowtooth halibut	18,650	—	1,412	—	5	20,067	3.0	—	20,067
Pac. black halibut	10,820	39	92	—	—	10,951	2.0	—	10,951
Flounders	9,200	—	830	—	—	10,030	1.0	—	10,030
Cod	16,547	45	2,136	—	—	18,728	2.0	—	18,728
Alaska pollock	309,613	21,346	29,820	1,180	—	361,959	52.0	—	361,959
Rockfish	31,877	824	15,106	2,088	2,536	52,431	8.0	176	52,607
Black cod	77	14	27	11	148	277	negl.	16	293
Herring	19,800	—	—	—	—	19,800	3.0	—	19,800
Atka mackerel	—	1,377	17,531	—	—	18,908	3.0	—	18,908
Pac. hake	—	—	—	—	156,708	156,708	22.0	1,799	158,507
Shrimp	—	—	1,706	—	—	1,706	negl.	—	1,706
Others	12,770	1,726	7,469	180	4,835	26,980	4.0	660	27,640
Total	429,477	25,375	76,177	3,471	164,232	698,732	100.0	2,651	701,383

Source: All-Union Scientific Research Institute of Marine Fisheries and Oceanography (VNIRO), Moscow, 1976.

Table 2.—Russia's 1975 fisheries catch (preliminary statistics by fishing grounds) off the Pacific coasts of the United States and Canada in metric tons.

Species	Eastern Bering Sea	Islands Aleutian	Alaska Western	Eastern Alaska	Wash., Oreg., Calif.	Total (U.S.)	Percent of U.S. total	Total Canada	Grand total
Alaska pollock	209,957	9,874	36,353	1,488	—	257,672	42.0	—	257,672
Pac. halibut	137	3	50	—	—	190	negl.	—	190
Other flounders	49,800	37	2,392	24	136	52,389	9.0	—	52,389
All rockfishes	26,915	11,877	10,014	201	2,292	51,299	8.0	239	51,538
Cod	24,043	184	1,392	92	—	25,711	4.0	—	25,711
Atka mackerel	462	6,377	17,249	2,750	—	26,838	4.0	—	26,838
Pac. hake	—	—	—	—	150,829	150,829	25.0	3,493	154,322
Herring	18.504	—	—	—	—	18,504	3.0	—	18,504
Shrimp	—	—	—	—	—	—	—	—	—
Others	17,500	257	6,775	201	2,598	27,331	5.0	82	27,413
Total	347,318	28,609	74,225	4,756	155,855	610,763	100.0	3,814	614,577

Source: All-Union Scientific Research Institute of Marine Fisheries and Oceanography (VNIRO), Moscow, 1976.

Table 3.—Total catches (in metric tons) allowed Soviet fishers during 1975-76 from the fishing grounds adjacent to U.S. Pacific coast, by area and species.

Area	Total catch allowed	1975 totals as % of catch quotas
Eastern Bering Sea		
Pollock	210,000	99.9
Herring	30,000	61.7
Other species	120,000	99.0
Gulf of Alaska		
Pollock	40,000	94.6
Rockfishes	10,000	102.2
Other species	30,000	103.1
Off the Aleutian Islands		
Rockfishes	12,000	98.9
Other species	16,000	104.6
Off Wash., Oreg., Calif. (south of lat. 47°45'N)		
Rockfishes (incidental catch only)	2,500	91.7
Other species (incidental catch only)	3,000	91.1
Pacific hake	150,000	100.6

Source: U.S.-USSR Agreement on North Pacific Fisheries, July 1975.

Venezuela Tells Foreign Fishing Vessel Rules

Fishing by foreign nationals aboard vessels of foreign registry within Venezuela's 12-mile Territorial Sea[1] is permitted in certain exceptional cases and under certain conditions. If the Oficina Nacional de Pesca (National Fisheries Office) of the Ministerio de Agricultura y Cria (Ministry of Agriculture and Livestock) deems it in the scientific or commercial interest of the nation, it may authorize foreign vessels to operate in Venezuelan-claimed waters.

Any request for such authorization must be solicited by the Venezuelan associates of the foreign vessel's owners. A monthly fee of at least 2,000 bolivares (US$467),[2] based on the vessel's size, must be paid to the National Fisheries Office. The entire catch must be landed and sold in Venezuela. In addition, depending on the vessel's size, 25 to 30 percent of the crew must be Venezuelan nationals.

The only restriction related to the fishing method used prohibits trawling for shrimp. Regulations concerning the licensing of foreign vessels are not codified and each application is weighed on its particular merit by the Venezuelan authorities. (Source: U.S. Embassy, Caracas.)

[1] The *Territorial Sea Law* of 27 July 1956, authorized territorial limits and an exclusive fishing zone of 12 nautical miles.

[2] Based on an exchange rate of US$1.00 = Bs4.28.

USSR Purchases Polish Sealing/Fishing Vessels

The Soviet foreign trading company *Sudoimport* concluded a contract at the 1971 Poznan International Fair with the ship-building industry of the Polish People's Republic for the delivery of 23 dual-purpose marine mammal trapping and fishing vessels. They were to be delivered to the Soviet Ministry of Fisheries between 1972 and 1975, reports the NMFS Office of International Fisheries.

The economic advantage of these unique dual-purpose vessels is that, upon completion of the short, 3-4 month seal trapping season, they can be shifted into commercial fishing operations for the rest of the year. The vessels initially will be used to hunt marine mammals, primarily seals, from small boats or on foot (on ice and ice floes). Skins will be processed aboard the vessels and commercial oil, frozen meat, and force-meat will also be produced. When the sealing season ends the vessels will fish using bottom and deep-sea stern trawling gear.

The *Zveroboi*, ordered in 1971, is the prototype of this class of 23 dual-purpose vessels built at the Lenin Shipyard in Gdansk, Poland. The *Zveroboi*-class vessels (see table) are designed for operations in the White Sea, in the North Pacific, northeast and northwest Atlantic Ocean, the Gulf of Alaska, and Bering Sea. Their hulls have been reinforced against ice and adapted to winter seas. The vessels are fitted with fish and fish meal processing equipment, modern navigational and fish-finding instruments, and an automated, remote-controlled, diesel-electric engine.

Up to 24 tons of fish or 600 seals a day can be processed aboard the *Zveroboi*-class vessels. Working at full maximum capacity, each of this class of vessels can produce 240 seal skins, 15 tons of frozen meat, and 1.2 tons of seal liver oil each day. In addition to the 24 tons of frozen fish, the vessels can also produce 12 tons of fish meal and small quantities of fish liver oil daily.

The entire order of 23 *Zveroboi*-class vessels was delivered by the end of 1975. Of these 23 vessels, 13 went into a new flotilla being formed in the Soviet Far East on Sakhalin Island. The *Zveroboi* is the flagship of this new fleet. The remaining 10 vessels joined the Archangel's Trawler Fleet. The *Serebrianka* and *Laplandiia* were the first two vessels constructed for this fleet in 1973.

Basic specifications of *Zveroboi*-class vessels.

Gross register tons	1,971 GRT.
Deadweight	800 DWT
Length (overall)	72.8 m
Length (between perpendiculars)	65.0 m
Breadth	13.0 m
Draft (fully loaded)	4.85 m
Horsepower	2,300 h.p.
Endurance	105 days
Speed (maximum)	13 knots
Speed (trawling)	4 knots

The *Zagorianii*, a standard vessel of the *Zveroboi*-class, was launched in late 1975 in Poland and sent to Nevel'sk on Sakhalin Island where it will be based. Three U.S. scientists, Francis Fay of the University of Alaska, James Estes of the U.S. Fish and Wildlife Service, and Howard Ferrin, a graduate student at the University of Alaska, participated in a U.S.-USSR cooperative walrus-ice seal research cruise aboard the *Zagorianii* from 12 March to 1 May 1976 in the Eastern Bering Sea.

Japan, Australia Discuss New Fisheries Agreement

The Fisheries Agency of Japan plans to begin talks with the Government of Australia about a new fisheries agreement or a further extension of the 1968 bilateral agreement. The 1968 agreement was to expire 27 November 1975, but was extended by mutual agreement to 27 November 1976.

A preliminary meeting in Canberra will discuss long-term arrangements concerning port privileges for Japanese fishing vessels, mutual cooperation in fishing technology, and joint ventures in marine product processing.

Japanese fishing vessels are presently allowed to call at the ports of Brisbane, Fremantle, Hobart, and Sydney. The 1968 bilateral agreement made it possible for Japan to resupply in these four ports a fleet of tuna longliners whose trips last as long as 6-12 months. Japanese tuna longliners fish off Australia, in the eastern Indian Ocean, and also off East Africa. Japan's tuna catch in waters near Australia is estimated at 25,000 tons annually.

Opposition to Japanese fishing off Australia has increased among Australian citizens. The Government appears cautious about granting unconditional or long-term permission for Japanese fishing vessels to enter Australian ports due to the effect such permission might have on Korea or other nations with longline fleets.

The Japanese delegation will include representatives of the Federation of Japan Tuna Fisheries Cooperatives (Nikkatsuren) and representatives of Japanese processors. Japan may discuss builting a plant designed for tuna *sashimi* export trade in Australia, as well as other cooperative ventures. (Source: *Nihon Keizai Shimbun.*)

According to the NMFS Office of International Fisheries, Australia's tuna catches, albeit still small when compared with those of other Asian tuna-fishing countries, are increasing rapidly (Tables 1 and 2). At the same time, international conflicts with Indonesia off Australia's northwest coast and Taiwan in the Gulf of Carpentaria have caused concern in Australian fishing circles about foreign fishing in waters near Australia.

Table 1.—Nominal catches of highly migratory species by certain nations of the western Pacific in FAO statistical areas 57, 71, and 81, (eastern Indian Ocean and southwestern Pacific Ocean), in metric tons.

Nation	1970	1971	1972	1973
Australia	9,200	9,900	11,000	14,600
Japan	164,800	176,800	167,600	186,600
Korea	56,100	50,800	52,900	16,600
Philippines	23,100	31,400	28,400	50,000
New Zealand	100	300	500	600
Other	48,400	53,800	28,300	25,000
Total	301,700	323,000	288,700	293,400

Table 2.—Nominal catches of highly migratory species by nation as percentage of total catch in FAO statistical areas 57, 71, and 81, (eastern Indian Ocean and southeastern Pacific Ocean) for years 1970-73.

Nation	1970	1971	1972	1973
Australia	3%	3%	4%	5%
Japan	55%	55%	58%	64%
Korea	19%	16%	18%	6%
New Zealand	0%	0%	0%	0%
Philippines	8%	10%	10%	17%
Other	15%	16%	10%	8%
Total catch in metric tons	301,700	323,000	288,700	293,400

(Sources: FAO *1973 Yearbook of Fishery Statistics*, and others.)

Iceland and Norway Okay Fishery Pact

The Icelandic Foreign Ministry announced the conclusion of a fisheries agreement with Norway on 10 March 1976. The agreement does not regulate the catch by a predetermined quota, but rather stipulates the total number of Norwegian vessels allowed in the 12-200 mile fisheries zone. While 45 vessels are authorized, no more than 30 may fish at one time. The agreement is valid from 15 February to 1 December 1976, and Iceland can reexamine the licenses at its discretion. The agreement may be terminated by either party after 6-months' notice. (Source: U.S. Embassy, Reykjavik.)

Peru and Poland Sign Fisheries Agreement

Peru and Poland signed a pact on 2 February 1976 to renew the 1971 Peru-Poland scientific and technical agreement that provided for increased cooperation in the fisheries sector. The new agreement, the second renewal of the 1971 basic accord, was signed by Polish Deputy Minister of Foreign Commerce and Marine Economy Edwin Wisniewski and Peruvian Fisheries Director Juan José Cardenas Ronco.

Wisniewski indicated at a press conference that Poland would, among other things, construct four factory trawlers for Peru instead of the three specified in the October 1971 agreement. He also stated that the first of these vessels would be delivered in January 1977. According to press reports, the new vessels would be used to catch bonito and "cojinova" (pompano) to supply Peru's domestic market. Wisniewski and Cardenas Ronco also signed a memorandum of understanding in which, according to press releases, Poland agreed to study Peruvian requests to:

1) Grant 10 scholarships to Peruvians for the study of fishery sciences in Poland beginning in 1976;

2) Provide a research vessel to carry out exploratory fisheries studies in Peruvian waters for 4 months each year; and

3) Send Polish fishing vessels to waters off Paita to help provide PEPESCA (Empresa Peruana de Pesca) with fish for human consumption. (Source: U.S. Embassy, Lima.)

According to the NMFS Office of International fisheries, Iceland's Foreign Minister Agustsson stressed that Iceland has the sole authority over the catch, and can limit it by restricting the number of vessels fishing. The agreement is important to the Icelanders as a demonstration of their ability to negotiate fishery agreements with foreign countries fishing off its coasts, in contrast to the alleged intransigence of the British. Iceland also recently announced a fisheries agreement with Belgium which allows 6,500 metric tons of fish (1,500 metric tons of cod) to be taken from Icelandic-claimed waters.

EC Sets Withdrawal and Reference Prices

The Commission of the European Communities (EC) has fixed the 1976 withdrawal prices on fishery products by Regulation (EEC) No. 3372/75 and reference prices by Regulation (EEC) No. 3373/75. These prices are published in European Units of Account (u.a.) per metric ton, and are based on various percentages of the guide prices according to coefficients for various commercial characteristics (size, quality, presentation, etc.) and distant landing areas. The coefficients are published in Regulation (EEC) No. 3371/75. The following withdrawal prices and reference prices have been converted to U.S. dollars per metric ton based on one u.a. equalling 1.16686 U.S. dollars. See tables 1-5.

According to the NMFS Office of In-

Table 1.—EC withdrawal prices (US$ per metric ton), by commercial characteristics and by region for 1976.

Species	Landing areas	Commercial characteristics [1]			Withdrawal price
		Freshness category	Size	Presentation	
Herring	1. All coastal areas of and islands of Great Britain north of a line from Fleetwood to Hartlepool; except the Isle of Man.	All	1	Whole	$153
		All	2	Whole	144
		All	3	Whole	90
	2. Coastal areas and islands north of a line from Loophead to Wicklow Head in Ireland.	All	1	Whole	179
		All	2	Whole	167
		All	3	Whole	104
Mackerel	3. Coastal areas of and islands off Ireland, Northern Ireland, Devon and Cornwall counties in Great Britain.	Extra	1, 2, 3	Whole	
		A	1, 2, 3	Whole in original boxes	131
		A	1, 2	Whole	
		B	1	Whole	
		B	2	Whole	116
		A	3	Whole	
		B	3	Whole	
		A	4	Whole in original boxes	107
		All	4	Whole	62
	4. Western, northern, northeastern coastal areas of Scotland to Aberdeen; islands to the west and north of these areas.	Extra	1, 2, 3	Whole	
		A	1, 2, 3	Whole in original boxes	84
		A	1, 2	Whole	
		B	1	Whole	
		B	2	Whole	
		A	3	Whole	74
		B	3	Whole	
		A	4	Whole in original boxes	69
		All	4	Whole	40
Whiting	5. Coastal areas of Ireland and Northern Ireland, the coastal area of Great Britain from Whitehaven in England to Wick in northeastern Scotland and the islands to the west and north of these areas; except the Isle of Man.	All	1, 2	Gutted w/head	243
		Extra, A	3	Gutted w/head	
		Extra, A	1, 2	Whole	
		B	3	Gutted w/head	219
		Extra, A	3	Whole	
		Extra, A	4	Gutted w/head	186
		B	1, 2, 3	Whole	
		Extra, A	4	Whole	
		B	4	Gutted w/head	135
		B	4	Whole	102
Sardines (Atlantic)	6. Coastal areas of and islands off the counties of Cornwall and Devon in England.	Extra, A	2	Whole	163
		Extra	3	Whole	125
		Extra	1, 4	Whole	106
		A	3	Whole	
		A	1, 4	Whole	68
		B	All	Whole	
Hake	7. All coastal areas of Scotland.	All	1, 2	Gutted w/head	459
		All	3	Gutted w/head	410
		All	4	Gutted w/head	323

[1] The freshness categories, sizes, and presentation are those defined pursuant to Article 2 of Regulation (EEC) No. 2142/70.
Source: *Official Journal of the European Communities*, No. L333/36.

ternational Fisheries, withdrawal prices and reference prices are part of the EC price support program. The withdrawal prices are those prices at which producer organizations start moving products from the human consumption market to the animal feed market. The reference price is the lowest price at which imports can enter the EC market.

Table 2.—EC withdrawal prices (US$ per metric ton) by commercial characteristics, for selected species for 1976.

Species	Commercial characteristics[1]			Withdrawal price
	Freshness category	Size	Presentation	
Herring	All	1	Whole	191
	All	2	Whole	180
	All	3	Whole	112
Sardines	Extra, A	2	Whole	371
Atlantic	Extra	3	Whole	284
	Extra	1, 4	Whole	240
	A	3	Whole	
	A	1, 4	Whole	153
	B	All	Whole	
Mediterranean	Extra, A	2	Whole	231
	Extra	3	Whole	190
	Extra	1, 4	Whole	163
	A	3	Whole	
	A	1, 4	Whole	123
	B	All	Whole	
Redfish (*Sebastes marinus*)	All	All	Whole	452
Cod	All	1, 2, 3	Gutted w/head	414
	Extra, A	1, 2, 3	Whole	
	Extra, A	4	Gutted w/head	300
	B	1, 2, 3	Whole	
	Extra, A	5	Gutted w/head	274
	B	4	Gutted w/head	
	Extra, A	4	Whole	
	B	5	Gutted w/head	200
	B	4	Whole	
	All	5	Whole	149
Saithe	All	1, 2, 3	Gutted w/head	257
	Extra, A	1, 2, 3	Whole	
	Extra, A	4	Gutted w/head	215
	B	1, 2, 3	Whole	
	B	4	Gutted w/head	158
	All	4	Whole	114
Haddock	Extra, A	1, 2	Whole	
	All	1, 2, 3	Gutted w/head	298
	Extra, A	4	Gutted w/head	260
	B	4	Gutted w/head	
	Extra, A	3, 4	Whole	187
	B	1, 2, 3	Whole	
	B	4	Whole	149
Whiting	All	1, 2	Gutted w/head	286
	Extra, A	3	Gutted w/head	
	Extra, A	1, 2	Whole	
	B	3	Gutted w/head	259
	Extra, A	3	Whole	
	Extra, A	4	Gutted w/head	218
	B	1, 2, 3	Whole	
	Extra, A	4	Whole	
	B	4	Gutted w/head	159
	B	4	Whole	119
Mackerel	Extra	1, 2, 3	Whole	
	A	1, 2, 3	Whole in original boxes	187
	A	1, 2	Whole	
	B	1	Whole	
	B	2	Whole	165
	A	3	Whole	
	B	3	Whole	153
	A	4	Whole in original boxes	
	All	4	Whole	88
Anchovies	Extra, A	2	Whole	384
	Extra	1, 3	Whole	300
	A	1	Whole	
	B	1	Whole	257
	A	3	Whole	
	B	2, 3	Whole	193
Plaice	All	1, 2, 3	Gutted w/head	399
	Extra, A	4	Gutted w/head	344
	B	4	Gutted w/head	295
	All	All	Whole	
Hake	All	1, 2	Gutted w/head	833
	All	3	Gutted w/head	744
	All	4	Gutted w/head	588
Shrimp (*Crangon* spp.)	A, B	1	Boiled	791
	A, B	2	Boiled	226

[1]The freshness categories, sizes, and presentations are those defined pursuant to Article 2 of Regulation (EEC) No. 2142/70.
Source: *Official Journal of the European Communities*, No. L333/34.

Table 3.—EC reference prices (US$ per metric ton) for selected fresh or chilled fishery products listed in Table 2 for 1976.

Products	Reference prices	Products	Reference prices
Herring	191	Whiting	299
Sardines		Mackerel	187
Atlantic	371	Anchovies	364
Mediterranean	231	Plaice	399
Redfish	452	Hake (*Merluccius*	
Cod	414	spp.)	833
Saithe	257	Shrimp (*Crangon*	
Haddock	298	spp.)	791

Source: *Official Journal of the European Communities*, No. L333/39.

Table 4.—EC reference prices (US$ per metric ton) for selected frozen fishery products for 1976.

Products	Reference prices
Sardines	313
Sea bream (*Dentex dentex, Pagellus*)	686
Squid (*Loligo* spp., *Ommastrephes sagittatus, Todarodes sagittatus, Ilex coindetti*)	1,364
Cuttlefish (*Sepia officinalis, Rossia macrosoma, Sepiola rondeleti*)	863
Octopus	674

Source: *Official Journal of the European Communities*, No. L333/39.

Table 5.—EC reference prices (US$ per metric ton) for selected frozen products for 1976.

Products	Presentation	Reference prices
Cod	Whole	449
	Fillets	1,162
Saithe	Whole	292
	Fillets	639
Haddock	Whole	333
	Fillets	895
Redfish	Whole	487
(*Sebastes marinus*)	Fillets	1,186
Mackerel	Whole	222
	Fillets	453
Hake	Whole	408
(*Merluccius* spp.)	Fillets	729

Source: *Official Journal of the European Communities*, No. 333/40.

Norway: Fewer Fishers But More Full-Timers

Norway's fishers are becoming steadily fewer but those left are more likely to be full-timers, a Central Bureau of Statistics survey shows. This confirms that structural changes evident since the war are still continuing, according to the Norwegian Information Service.

The survey found 31,800 fishers last year, a drop of 3,200 since the last count in 1971. On the other hand, the number working full-time in the trade rose from 14,700 in 1971 to 16,600 or 52 percent of the total by 1975.

Texas Reports Eye Seafood Consumers, Recreational Facilities, Sport Shrimping, and Marina Management

Consumer attitudes toward seafood and socio-economic aspects of seafood consumption are explored in **"An Analysis of Seafood Consumption Patterns and Product Perceptions in Texas"** (TAMU-SG-75-216) by Samuel M. Gillespie and Michael J. Houston.

Consumers, say the authors, view seafood as a nutritious and relatively economical meat item although they do not eat it in quantities comparable to red meats and poultry. Ease of preparation and family tastes reportedly helped determine attitudes affecting seafood consumption.

Persons who lived near (within 50 miles) of the coast while growing up were found more likely to eat seafood in the home later in life, and the frequency of seafood consumption increased as status (job, education, income) improved. The authors report finding no discernible market segment for finfish except "coastal proximity while growing up." They suggest recipe demonstrations and in-store sampling programs as an effective—though expensive—way to increase family seafood consumption.

"A Recreational Guide to the Central Texas Coast" (TAMU-SG-75-606) by Edwin Doran, Jr. and Bernard P. Brown, Jr. is an extensive compilation of some 528 facilities of interest to Texas marine recreationists. Described and mapped in its 132 pages are the facilities and coastal area between, but excluding, Galveston and Rockport. Neither were listings sought in such larger cities as Freeport, Palacios, and Port Lavaca.

Facilities listed are mostly within 10 miles of the coastline. The booklet identifies motels, launch ramps, and marinas with a location code number shown on a map at the first of each of the 11 sections. Listings also include restaurants, parks, campgrounds, refuges, boat repair shops, grocery/liquor stores, bars, filling stations, hotels, bait shops, and boat rentals.

"A Feasibility, Management and Economic Study of Marinas on the Texas Gulf Coast" (TAMU-SG-76-201) by John L. Compton and Robert B. Ditton disputes several widely held beliefs about marinas on the Texas Gulf Coast. Of the 29 marinas studied all were individually owned or held by groups of 3-4 people. No major corporations operated any marinas and there was no evidence that the businesses changed hands quickly.

The study further suggests that marinas would make attractive financial investments and that the operators were not using them for tax write-offs. Said the authors, ". . . most of the marinas studied were operated by people working long and hard to earn a living from them." No new marinas were developed along the Texas Gulf Coast in the 9 years prior to the 1974 study, although boat sales had boomed nationally.

The study also provides data on marina profitability, real estate costs and interest charges, construction costs, boat storage and pricing strategies, marina site considerations, physical planning, environmental controls, labor and management constraints, and other economic details.

The above three booklets, $2.00 each, can be ordered by name and publication number from the Department of Marine Resources Information, Center for Marine Resources, Texas A&M University, College Station, TX 77843.

How anglers can get fresh shrimp dinners, bait, and have fun in the process is covered in a new Texas A&M University bulletin. **"Sport Shrimp Trawling"** (TAMU-SG-76-503) by Gary Graham outlines the necessary equipment, state regulations, how to rig and set the trawl and otter door, and how to repair the net. Graham is associate marine fisheries specialist for the Texas Agricultural Extension Service at the University.

For many, this will be a new pursuit and a refreshing diversion for anglers who own boats, Graham says. Necessary equipment (trawl, otter doors, tow lines) will cost from $100 to $150, depending on the size of the trawl.

The bulletin is available free of charge from the Center for Marine Resources, Texas A&M University, College Station, TX 77843. Requests should include title and publication number.

Lake Superior's Fish and Fisheries Reviewed

Publication of **"Fish of Lake Superior"** (WIS-SG-76-124) has been announced by the University of Wisconsin Sea Grant Program. The 36-page, small format (6 × 9 inches) booklet outlines the history of the Lake Superior fisheries and gives thumbnail sketches of 23 species that inhabit the lake, including the coho, chinook, and pink salmon.

Data include approximate adult size, color, common names, some natural history notes, and the historical anecdotes. Each species is illustrated with a black and white drawing adapted from the NMFS full-color wall chart, "Fishes of the Greak Lakes."

"Fish of Lake Superior" was written by Warren Downs, associate editor of the University of Wisconsin's Sea Grant Program. The booklet is available from the Sea Grant Communications Office, 1800 University Avenue, Madison, WI 53706. An earlier booklet, "Fish of Lake Michigan" (WIS-SG-74-121) is also available from the same office.

Gulf of Mexico Water Temperature Data Printed

A compilation of Gulf of Mexico water temperature data gathered over the past 20 years has been published by the Sea Grant College Program at Texas A&M University. Authors of the marine advisory bulletin, **"Water Temperature on the Texas-Louisiana Shelf,"** are Paul C. Etter, graduate student in oceanography at Texas A&M, and John D. Cochrane, associate professor of oceanography at A&M.

"The publication summarizes a vast amount of temperature data. It will be useful in studies of marine life and in continuing offshore oil and mineral operations," said Etter. It is available from the Sea Grant College Program, Texas A&M University, College Station, TX 77843. Request publication TAMU-SG-75-604.

Books Define Fish Quality, Preservation

High quality, appealing fish benefit everyone from the fisher to the consumer. And the consumer, writes J. J. Connell, Assistant Director of the United Kingdom's Torry Research Station, Aberdeen, Scotland, is the ultimate arbiter of fish quality. Connell has authored **"Control of Fish Quality"** which examines, in non-technical language, ways to gauge and protect fish quality.

The opening chapter defines fish quality as "all those attributes which consciously or unconsciously the fish eater or buyer considers should be present." Chapter two examines intrinsic factors that govern fresh fish quality and chapters three, four, and five discuss fish quality deterioration, fish product defects, factors that affect such changes, and how they can be controlled.

The author reviews sensory, microbiological, mechanical, instrumental, statistical, and laboratory methods of assessing fish quality in chapter six. Other chapters include industrial quality control and the organization of quality control and official inspection in such countries as Canada, European Economic Community, India, Japan, Norway, and the United States. Various codes of practice and standards for commercial fish products are also listed.

Well illustrated, the book is not limited to just British fisheries and would be useful to many. It has 179 pages, 44 illustrations, is of small (5½ × 8½ inches) format, and is indexed and contains numerous suggested references, by chapter, for further reading. It is published by Fishing News (Books) Limited, 23 Rosemount Avenue, West Byfleet, Surrey, England, and costs £6.50 plus five percent for postage and handling. The firm also offers its catalog of books on many aspects of fisheries aquaculture and commercial fishing.

A revised edition of **"Ice in Fisheries,"** by J. J. Waterman and J. Graham, has been published by FAO. The authors are with the Torry Research Station, Aberdeen, Scotland. Prepared for FAO's Fish Production and Marketing Service, the 57-page soft-bound booklet has been popular in both developed and developing countries.

The authors discuss the preservative effect of chilling, the nature and properties of ice, ice making equipment and ice plants, other chilling methods (i.e., refrigerated seawater and superchilling), chilling fish at sea and on land, temperature measurements, properties of water and ice, and lists metric, British and SI Unit conversion factors. A well-illustrated, practical volume, "Ice in Fisheries" is available at $3.50 per copy from Unipub, Box 433, Murray Hill Station, New York, NY 10016.

Foreign Fishery Note Back Issues Available

The NMFS Office of International Fisheries has a limited supply of several previously issued "Foreign Fisheries Leaflets." Anyone interested in receiving a free copy of the leaflets listed below may order them from the Division of International Fisheries Analysis (F41), Office of International Fisheries, NMFS, NOAA, U.S. Department of Commerce, Washington, DC 20235.

Requests will be honored as long as the supply lasts. Please enclose a self-addressed label to facilitate mailing. The available leaflets include: Persian Gulf Fisheries; The Commercial Shrimp Potential in West Africa, from Dakar to Douala; FFL 26—Industrial Outlook Report of the Taiwan Fishing Industry, 1969; FFL 56A—Norway, Fishery Landings, 1967-1970; FFL 120—Fisheries of the Democratic Republic of the Congo; FFL 150—The Fisheries of Equatorial Guinea, 1970; FFL 189—Canada's Fisheries Closing Lines, 1971; FFL 72-6—The Commercial Fisheries of Portugal, 1970; FFL 72-11—Thailand Fishery Trends, 1972; FFL 73-12—Marine Fisheries of the Federal Republic of Germany, 1970-1971; FFL 73-16—Review of the Indonesian Shrimp Fishery, and its Present Developments; FFL 73-21—Fisheries of Chile, 1971; FFL 74-3—Fisheries of the Gambia, 1973; FFL 74-9—Fisheries of Tanzania, 1972; and FFL 74-12—Fisheries of the Cameroons, 1973.

A Sportsman's Guide to Blue Crabs and Crabbing

On the U.S. Atlantic coast the blue crab is avidly sought by sport crabbers with varying degrees of success. It is also accessible to those who know its habits and crabbing techniques. **"Successful Crabbing,"** by Ernest J. Cottrell, Frank L. Mellaci, and John B. Cottrell, is a concise source of information on the life, and the catching, cleaning, and cooking of the blue crab.

The book is divided into three parts. The crab's life, from birth through adulthood, is related in Part I. Part II, Crabbing for Fun, tells various ways to catch hard crabs (i.e., traps, seining, hand-lining, and taking them from piling under docks and bridges). Techniques for taking soft-shelled crabs include crabbing from a boat, walking or wading the edge of an estuary, and seining.

Part III, Cooking and Eating Crabs, lists techniques for both hard- and soft-shelled crabs. Lump (or backfin), flake, and claw meats are described. Cooking and picking methods are described and cleaning techniques for both hard- and soft-shelled crabs are illustrated with photographs. Recipes for both types are also included.

This is a good but brief (76-page) basic guide to sport crabbing. For those who want to know more about the blue crab, and extensive bibliography is provided. A glossary helps with the technical terms used. "Successful Crabbing" is published by, and available from, the International Marine Publishing Company, 21 Elm Street, Camden, ME 04843 and costs $5.95.

Redfish, Whitefish, and Bluefish

. . . . **The 6,000 tagged 6-inch redfish released in** Texas' Matagorda Bay in late April represented the single largest such release in the state, the Parks and Wildlife Department reports. The young fish were part of several hundred thousand obtained from brood fish at the Port Aransas Laboratory of the National Marine Fisheries Service. In another development, a 9-inch redfish caught at Lake Creek Reservoir south of Waco was the first evidence for P&WD biologists that any of the 13,000 redfish fry stocked there last fall survived and grew. Said the P&WD, "The impressive 8-inch-plus growth in 6 months shows that saltwater game fish can survive and grow in Texas' freshwater lakes and reservoirs . . . .

. . . . Virginia Institute of Marine Science scientists Frank Perkins and John Dupuy flew to Europe in mid-May to **confer with oyster disease researchers there on the Aber Disease** of European oysters which they believe is in the same group of shellfish pathogens as MSX. Perkins is presently investigating the comparative biology of MSX in relation to the Aber disease organism and others in the same pathogen group in Australian, Japanese, and Korean oyster growing areas . . . .

. . . . **To prevent conflicts with recreational boaters, the Pine Island Chapter** of the Organized Fishermen of Florida has designed a special flag to mark their "stab" or "sink nets" used to catch migrating pompano. The nets, sometimes submerged only a few inches, can be vulnerable to passing boats. The triangular, 18- x 12-inch Flag is fluorescent orange with a white circle, according to the Florida Cooperative Extension Service . . . .

. . . . **A survey of the gut contents of bluefish and striped bass** is being conducted by the University of Rhode Island and researchers are asking anglers for help. Candace Oviatt and Bruce Rogers of URI's Graduate School of Oceanography want to know what the bluefish and stripers eat and what part menhaden play in their diet. Besides the visceral material, the researchers want the date, time, general location, and method of capture, length and weight of the fish, and a scale sample . . . .

. . . . **Spotter airplanes used by comial swordfishers have been grounded** by the California Fish and Game Commission. The 30 April vote allowed a 2-year-old law banning the use of the spotter planes to go into effect on 28 June. The commissioners also unanimously voiced their desire to ban longline swordfishing at a later date . . . .

. . . . **Sailfish along Florida's southeast coast may be growing more plentiful,** according to a *Florida Conservation News* report. Since 1970, Florida Department of Natural Resources scientists at the West Palm Beach Field Station have been monitoring and recording the number and size of sailfish caught. While a stock decline along the southeast coast was assumed, 1976 brought a bountiful sailfish season off Stuart and West Palm Beach . . . .

. . . . **Corvina, native to the Gulf of California and transplanted** to California's Salton Sea in the 1950's, have failed to survive Texas' colder waters, the Texas Parks and Wildlife Department reports. Some 124 corvina, to over-winter at the Palacios Marine Fisheries Station, disappeared between November and late February when the ponds were drained. Water temperatures dipped to 34°F during a January storm. Had the fish survived, biologists would have evaluated their potential as a new coastal game species . .

. . . . The South Atlantic Committee for Shrimp Management has proposed a **regional permit system for shrimp trawlers from North and South Carolina, Georgia and Florida** according to *The Marine Newsletter.* The Committee is a State-Federal group created in 1973 to develop a management plan for the shrimp fisheries of those states. The proposed permit would allow commercial shrimpers from any one state to fish off the coasts of the other cooperating states, though each boat would still be required to have a resident license issued by its home state. To become law, the proposal would have to be accepted and passed by the legislatures in each of the four states . . . .

. . . . About 1.7 million **whitefish fry were released in Wisconsin's Great Lakes waters** in April for the first time in many years, the Department of Natural Resources reports. Egg-taking problems in both lakes last fall thwarted more intensive stocking. In 1975, Wisconsin's Lake Michigan waters produced 1.3 million pounds of whitefish—exceeded in the last 35 years only by the 1947 harvest of 1.8 million pounds. Lake Superior waters produced 294,000 pounds, the biggest harvest in 20 years. Increasing whitefish harvests are attributed to successful lamprey controls . . .

. . . . **Two Atlantic right whales were observed about 8 miles off South Carolina** in March, according to the Wildlife and Marine Resources Department. The species is one of the rarest to visit the state's waters. The whales—about 50 and 35 feet long—were first spotted by the crew of a Charleston Harbor pilot boat and reported to the Marine Resources Center at Fort Johnson. Only three other reports of the right whale have been recorded there, one each in 1800, 1880, and 1974 . . . .

. . . . **Alaska's fifth private, nonprofit salmon hatchery permit was issued** on 28 April to the Alaska Aquaculture Foundation of Wrangell for the outlet stream from Burnett Lake on Etolin Island by the State Fish and Game Commission. Operation of such hatcheries was authorized by the State Legislature in 1974, and two operated last winter. Sheldon Jackson College began releasing about 2 million pink salmon fry in late March, and the Prince William Sound Aquaculture Foundation planned to release about 3 million pink salmon fry during May . . . .

. . . . **The Fisheries Society of the British Isles has announced a symposium** on "Rhythmic Activity of Fish." The dates will be 4-8 July 1977 at the University of Stirling. Topics include: Hormonal controls; behavioral rhythms; community relationships; and methods and instruments. Further details will be available in October from John Thorpe, Department of Agriculture and Fisheries for Scotland, Freshwater Fisheries Laboratory, Faskally, Pitlochry, Perthshire, PH16 5 LB, Scotland . . . .

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary product or proprietary material mentioned in this publication. No reference shall be made to NMFS, or to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends or endorses any proprietary product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this NMFS publication.

UNITED STATES
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SCIENTIFIC PUBLICATIONS STAFF
ROOM 450
1107 N.E. 45TH ST.
SEATTLE, WA 98105

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-210

Controlled Circulation Rate

U.S.MAIL

MFR XEROX300XCISSDUE006R 1
XEROX UNIV MICROFILMS
SERIALS DEPT
300 N ZEEB RD
ANN ARBOR MI 48106

AMERICAN REVOLUTION BICENTENNIAL 1776-1976 ™

76 AMERICA'S FIRST INDUSTRY